UNIVERSITY
OF MICHIGAN
MAR 12 1953
FORESTRY
LIBRARY

WORLD CROPS

embracing

AGRONOMY, HANDLING, PROCESSING, STORAGE AND PROTECTION
SOILS, CHEMICALS, IRRIGATION, ENGINEERING AND ECONOMICS

The Rotavator 'Gem' Cultivating Roses in South Africa

VOLUME 5, No. 3 **MARCH 1953**

A Publication of The Leonard Hill Technical Group

FORMULATORS FOR WORLD CROPS

THE secret of successful crop treatment whether with insecticide, fungicide or weedkiller, depends entirely upon correct formulation of the basic chemicals. P.B.I. specialise in formulating and can offer the best of all modern pesticides in a form for easy effective application. Standard formulations are available and customers' own requirements can be investigated and special products evolved.

TOXAPHENE FORMULATIONS manufactured under licence as ready-for-use products supplying the main requirements for this insecticide.

BRUSHWOOD KILLER to eradicate blackberry and woody growth in scrub-land. Ideal for treatment of road-sides to prevent scrub encroachment.

SOLUBLE D.N.O.C. SELECTIVE WEEDKILLER for selective weedkilling in cereal crops complete with activator, in great demand for medium volume spray application.

BENZENE HEXACHLORIDE FORMULATIONS – a complete range.

D.D.T. FORMULATIONS – D.D.T. / Thanite concentrates for fly sprays. Dusts and wettable powders milled to 300-mesh with suitable inerts.

Telephones: Waltham Cross 3215-3216

Telegrams: 'Panbritan' Waltham Cross

PAN BRITANNICA INDUSTRIES LTD.

WALTHAM ABBEY · ESSEX

WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

Vol. 5. No. 3. MARCH 1953

CONTENTS

EDITORIAL COMMENT:
Overseas Food Corporation; Community Projects in India: Search for New Cocoa Types; Biological v. Chemical Control; Bangkok Rice Meeting; Decontrol of Feeding Stuffs in Britain; Can Nutrients be Insoluble? Food Production in Hong Kong; British Forests, Present and Past 89

World Timber and Pulp—Requirements and Supplies —*J. J. MacGregor*, B.LITT., B.SC., M.SC. 93

Agricultural Possibilities of Morocco—*C. H. Brown*, B.SC. 98

Legumes in Tropical Agriculture—*R. O. Whyte*, PH.D., B.SC. 101

Changes in the Fertiliser Industry of the United States —*Harry A. Curtis* 105

Developments in Drift Spraying—*R. J. Courshee*, B.SC. 109

The Cuttack Rice Research Institute 112

Industry's Contribution to Agricultural Research—No. 15: The Pure Seed Company—*H. Hunter*, M.A., D.SC. 113

Research Developments: Sytam—A New Systemic Insecticide; Milking Machinery Development ... 117

New Books 118

Colonial Agricultural Research, 1951-52 120

Farm Machinery 121

People in the News 123

Copra, Cocoa and Coffee Exports from the South Pacific 124

Plant Hormones—Fourth Annual Fernhurst Lecture 125

The American Market Garden 127

Bulletins and Reports 128

World Crop Reports 129

Published monthly by Leonard Hill Limited, Stratford House, 9 Eden Street, London, N.W.1, England (Tel. Euston 5911)

Subscription rates : *1 year 8 dollars, 3 years 20 dollars, paid in advance*

The Rotavator 'Gem' Cultivating Roses in South Africa

Many rose growers at home and abroad have found the Howard Rotavator 'Gem' the most useful tool for preparation of the soil for planting and for inter-row cultivation before the trees have made much growth. Rotavation is a good method for both budded and unbudded stock. Set shallowly, the hoe blades do a good job of surface scuffling, keeping weed growth well under control, as is shown by the cover picture of a 'Gem' operating in a rose nursery at Krugersdorp.

Rotary Hoes Ltd., Horndon, Essex, England

plants and animals need **MANGANESE . . .**

Manganese salts solve deficiency problems in the cultivation of economic crops and in the feeding of farm animals . . .

INFORMATION about the use of suitable manganese compounds in the control of manganese deficiencies may be obtained from our Advisory Department. If your local distributor cannot help you about supplies, please communicate with us.

CHEMICAL AND CARBON PRODUCTS LIMITED

24/II St. George Street Hanover Square · London · W1

Cables : Chemicarbo, London *Phone : MAYfair 7132*

If you have this Problem

You need a CUTHBERTSON

The Cuthbertson Type "S" Machine was originally designed for draining and ridging work in flat land on Sugar Cane Plantations, and has proved to be of great service in the West Indies and elsewhere.

This machine has also been adapted for work in soft peat conditions, where it is necessary to move the 'spoil' some distance from the side of the drain. Type "S" machines are now working successfully in these conditions on various Peat Development Schemes in Eire.

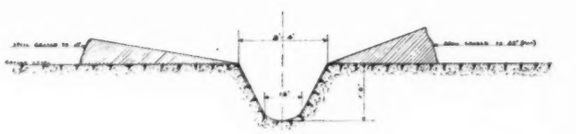
The mouldboard of this machine is designed to eject the "spoil" on either side of the drain, and a centre splitting disc is placed between the two side cutting discs, to split the furrow.

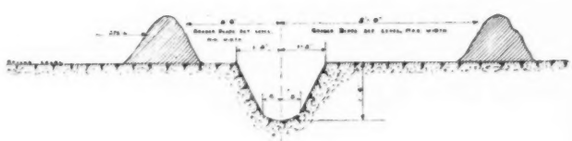
Two stout grader-wings are constructed on either side of the mouldboard, for the purpose of pushing the soil away from the side of the drain. These wings can be adjusted vertically and horizontally in order to obtain any desired bevel, as illustrated by the drain profile diagrams. In cultivated soil the wings can be set to cut away the top portion of the side of the drain (Profile No. 3) thus allowing the mouldboard to cut a greater depth of drain.

It is possible to interchange the mouldboards of our machines, and by purchasing a composite Type "S" Machine and a Mouldboard of the type "F" Mark II variety, or vice versa, a considerable number of drainage operations can be undertaken.

We are always prepared to give advice on any specific problem and to advise on the correct methods of overcoming special difficulties.

Drain Profiles cut in any type of soil





Drain Profile - in tilled soil only

CUTHBERTSON

KELVIN CONSTRUCTION CO., LTD.

KELVIN WORKS · LOCHBURN RD · GLASGOW · SCOTLAND

TELEPHONE: MARYHILL 1192 TELEGRAMS: "PREVAILING" GLASGOW

Editorial Comment

The Floods in Europe

The storms and high tides of January 31 produced one of the worst disasters on record in England and the Netherlands. Sea defences on the east coast of England and in Holland and Belgium crumbled, and the sea broke in causing widespread destruction and loss of life. Probably the worst material feature is the havoc wrought to crops and agricultural lands. The sympathy of the world goes to the sufferers coupled with good wishes for early success in efforts to repair the damage.

Overseas Food Corporation

REORGANISATION of the work of the Overseas Food Corporation in conformity with the terms of the White Paper (Cmd. 8125) has been in progress since the early days of 1951, and the report and accounts for 1951-52, published recently by the Stationery Office represent the first record of a complete year's working under the new regime.

As readers will remember, the decision taken by the White Paper was the abandonment of the original objectives of the Groundnuts Scheme, and the substitution therefore of a programme with limited objectives designed to explore the possibilities of the region and to evolve a plan on which the areas already cleared could be utilised and developed to the advantages and for the benefit of the inhabitants of Tanganyika.

It may be recalled that the original project was launched with the idea of counteracting to some extent the world shortage of oils and fats which was then believed to be imminent as a result of the destruction and havoc wrought by the war, and notably by the Japanese in the Far Eastern region.

Actually, in the event the shortage has failed to materialise, and world recovery in vegetable oil production has exceeded the most optimistic expectations. It is probably fortunate for the world that this has been so since, had too great reliance been placed on the ability of this well-intentioned but over optimistic undertaking to supply badly needed oils and fats, the results would have proved even more disappointing than they actually did.

Today the report gives some indication of how things are going under the new regime. To tell the truth, once again it is not too encouraging. We learn that although the Corporation has operated within the greatly reduced financial provisions laid down, the agricultural trading accounts covering one harvest and one complete season present a disturbing picture, and that it is now evident that the estimated crop yields, especially for the main cash crop of groundnuts, cannot possibly be obtained, especially at Urambo and in the Southern Province.

The final conclusion is that until much more has been learned of the basic principles applicable, little progress can be expected. Some alternative crops show promise but, for the reasons given, the Board have recommended to the Secretary of State for the Colonies a slowing down of the tempo of operations in both regions.

All this is distinctly discouraging and indeed it does not look so far as if the efforts of the Government to ' save the pieces ' are having a large measure of success.

Community projects in India

A CRITICISM of the work of the Departments of Agriculture in India in the old days was that although they achieved much in the performance of agricultural research, the success they attained in inducing the Indian peasant cultivator to adopt modern agricultural methods and improved processes in substitution for the traditional inefficient methods of the past was, to say the least of it, disappointing.

Of all the tasks which face the professional agricultural worker this one of influencing backward and ignorant peasantries to adopt modern methods is among the hardest. Yet it is probably the most important, inasmuch as money expended on agricultural research is money wasted if the results are not ultimately translated into practice in some shape or form.

It is interesting news, therefore, that apparently the Government of India are now embarking on launching throughout the subcontinent a new scheme to revitalise and improve conditions of village agriculture and village life, under the title of ' Community Projects.' The main and immediate object is increased food production by encouraging and providing facilities for supplying improved seed, implements and fertilisers, the adoption of improved methods of cultivation, fighting pests and diseases, and giving guidance and help in marketing produce. Added to this will be the encouragement and fostering of cottage industries, while the scheme will also cover all aspects of village welfare, including health, sanitation, education, housing and communications through organised efforts towards developing a spirit of self-help among villagers.

We gather that for a start there are to be 55 project areas spread over the whole country, each area including about 300 villages, and it is anticipated that in five years there will be about 500 projects in all, covering the whole rural area of India.

Apparently the project has considerable backing from Indian leaders and experts, while it is also receiving financial aid and technical support from the United States of America. Indeed, this particular concept of the form which extension work in underdeveloped areas can effectively take is largely an American growth, although, with some modifications, it has been adopted in some British colonies.

In the U.S.A. it is reported to have given good results in backward village areas. It has also been developed in Mexico and certain South American countries under American auspices with success. About a dozen years ago the attempt was made to adopt it with some help from

American sources in the British colony of Cyprus, although information is not available to us of the success it achieved.

In Uganda the same idea underlies the considerable schemes for development and improvement which have been in progress under the Government of that country for some years.

The projected development in India appears, however, to be the largest attempt of its kind so far launched. It is to be hoped that it will make a successful contribution to what after all is the greatest problem with which the Government of India is faced, the improvement of the living standards of the Indian peasant.

Search for new cocoa types

IN our issue of December last we commented upon an expedition organised by the British West Indies Cocoa Research Scheme, the headquarters of which are at the Imperial College of Tropical Agriculture in Trinidad, to explore the jungles of the Amazon basin for new varieties of cocoa to be used in breeding new commercial types.

It appears that this expedition set out on its mission in June-July last and has now returned to Bogota, whence certain of the members have gone back to Trinidad, their places being taken by other members of the cocoa research staff.

The original members of the expedition comprised Professor R. E. D. Baker, pathologist, Mr. F. W. Cope, plant breeder, and Mr. D. J. Taylor, entomologist, all of the Imperial College.

During their nine weeks' survey of parts of the Apaporia and Caqueta rivers the expedition encountered no less than seven species of Theobroma and two of Herrania. However, only Theobroma cacao, T. bicolor and two species of Herrania yielded seeds at the time of their discovery, which could be shipped to Trinidad, the others being out of crop or else the pods had been spoilt by monkeys. If the five other species of Theobroma are not discovered elsewhere during subsequent searches it may be worth while to return to the area in which they were found at a later date this year.

The expedition is now being extended with the replacement staff to other parts of the Colombian region.

It is somewhat disappointing that the material so far discovered appears little likely to be of use in the breeding programmes of the Research Centre, but the explorations undertaken cover only a rather restricted area of the vast Colombian jungles and there still remain good hopes that in expeditions to other parts of these areas good commercial types suitable for breeding work will be found.

Biological v. chemical control

AN interesting case of conflict between chemical and biological methods of pest control has been reported in the *New Zealand Journal of Science and Technology* (1952, 34, Section A, 3, 258). Woolly aphis has long been a serious problem in New Zealand orchards and important apple varieties such as Cox's Orange Pippin and Jonathan could probably never have been established there if the parasite of woolly aphis, *Aphelinus Mali*, had not been introduced with what is described as 'spectacular success.' With the post-war appearance of DDT for more general spraying, however, growers have noticed a steady increase in woolly aphis infestations. Investigations over the period 1945-50 by the Plant Diseases Division of New Zealand's D.S.I.R. have now been reported. A notable finding is that DDT does not affect woolly aphis but kills large numbers of the parasite *A. mali*. Nevertheless, a spray or dust control method for woolly aphis seems necessary, for even under favourable conditions serious early damage can be done by the pest before the parasite population has built up to sufficient strength for completely effective control. Biological control has been a success in the sense that it has kept woolly aphis infestation within tolerable bounds, but fluctuations in the pest-parasite balance have often allowed these interim periods of relatively unchecked activity for woolly aphis to appear.

Although DDT failed to kill the pest, BHC proved to be highly effective. For specific action against woolly aphis BHC was particularly outstanding; nicotine, parathion, and DNC-oil emulsions having been tried also, without much success. Unfortunately, technical BHC taints the fruit if sprayed in the growing season, but this difficulty was overcome when it was found that BHC treatment in the dormant season still gave good control over woolly aphis. Later work has now shown, however, that gamma-isomer BHC (lindane) can, as would be expected, be used in the growing season without risk of tainting. BHC also had adverse effects upon the *A. mali* parasite, but not apparently as severe as DDT; in any case the heavy reduction in woolly aphis population resulting from BHC spraying has led to natural reductions in the parasite population.

On the whole, notwithstanding the success given by the *A. mali* method of control, the speedier and more certain control given by a specifically suitable chemical insecticide makes the latter method seem preferable. As it is now known that gamma-isomer BHC is effective as a summer spray for most apple pests, New Zealand growers may well find that this insecticide can become the main weapon in their general spraying programmes, displacing DDT altogether.

The Bangkok rice meeting

IN continuation of our editorial comment last month, the International Rice Meeting convened under the auspices of FAO at Bangkok on January 5 was successfully held as planned. It took place under the chairmanship of Sir Herbert Broadley, Deputy Director-General of FAO.

More than 70 delegates from 20 countries attended, among which all the Asian states producing and consuming rice except Communist China were represented, as were also the U.K., the U.S.A., France, Australia, Cuba, Ecuador, and a number of other nations.

The agenda for the conference included such subjects as government policies in regard to rice, *e.g.* subsidies and price guarantees, credit facilities for cultivators, land tenure, resettlement of rice farmers; also matters relating to the marketing of rice, technical assistance, etc.

As a basis for discussion the FAO secretariat had prepared

a comprehensive review of the recent trends in the production and international movement of rice, which outlined the present position and its grave dangers.

In his opening address Sir Herbert Broadley pointed out that the gathering was the most widely representative of all the rice meetings sponsored by FAO, and expressed the belief that important results would follow it.

We hope that it may be possible for us to publish a report of the conference in a subsequent issue.

De-control of feedingstuffs in Britain

THE announcement in the British white paper issued on January 21 that the Government intends to put an end to the rationing of feedstuffs, the subsidy on feedstuffs and the controls on the prices of cereals certainly clears the air and removes any doubts that may still have existed about the intentions of their agricultural policy. Most people will probably agree that in principle it is a step in the right direction. The vast structure of controls, subsidies and price fixing which agricultural industry has had imposed upon itself as a consequence of war and post-war events, coupled, it may be suspected, with the enthusiasm of a Socialist Government for planned economy in all things, has been a heavy burden on the farmer. No doubt in Socialist eyes it possessed the additional advantage of creating employment through the large amount of additional official work it necessarily involved; but to the busy farmer the restraints on his purchases and the irksome task of perpetual form filling have for years been a burden which all would see disappear with unqualified relief, provided they were satisfied that it would not have unfavourable repercussions on trade and prices.

The Minister of Agriculture, Sir Thomas Dugdale, did his best to allay such apprehensions in a speech at Northallerton on January 10 when he obviously had in mind the impending issue of the white paper. He advised his hearers to beware of groundless fears and assured them that they would not be let down, emphasising that the Government fully accept the obligation implicit in the 1947 Agriculture Act 'of promoting by the provision of guaranteed prices and assured markets, a stable and efficient agricultural industry.'

It is well to recognise that hitherto the Government has subsidised feedingstuffs to the amount of £25 million a year, and though world prices may fall somewhat, it seems, nevertheless, inescapable that the bulk of this cost must be transferred to the shoulders of the consumer, *i.e.* the farmer in the first place, but in the end the ordinary man in the street. It should mean some reduction in taxation, but will this cheapen the cost of living adequately to compensate for the rise in price of agricultural produce ?

One wonders, moreover, how the Government proposes to honour its promises to assist agricultural industry. Price support on the lines established in the United States seems one method, but the working out of a programme seems unlikely to prove a simple and easy proposition.

The British position has its interest and its lessons for every country, especially at present when the need for stepping up food production is still as urgent as ever. Certainly British agricultural policy at present indicates a willingness to follow sound and common sense lines. Let us hope, despite the many difficulties, that it will succeed in stabilising the outlook without adding too grievously to the still soaring cost of living.

Can nutrients be insoluble?

NOT many years ago it was one of the cardinal 'laws' of plant-growth that plants could not assimilate mineral nutrients through their leaves. Then came the successes of foliar spraying with trace element solutions, to be followed later by foliar spraying for nitrogen. Now a 'law' that has seemed even less vulnerable—that plants can take up nutrients only if these are dissolved in the soil solution or in a culture solution—is swaying and perhaps tottering. An ingenious experiment at the Michigan State College appears to have proved that two trace elements, iron and manganese, can be taken up by growing plants without being dissolved first. Contact between plant roots and the insoluble material seems to have provided satisfactory conditions for the passage of the nutrients into the plant.

If the design of the experiment is to be fully appreciated, it is necessary to go a little farther back and to describe the new kinds of trace element fertiliser now being developed in America. This is a fused 'frit' or porcelain-like substance which contains most of the trace elements. Owing to its almost negligible water-solubility, it was believed that this type of material would release trace elements so slowly that large losses from soil fixation would be obviated, thus overcoming the major weakness of soluble forms of trace elements. This type of material was employed in the Michigan experiments, a 'frit' containing only iron and manganese being used. Two solution-culture vessels were connected to the same feed-vessel. One culture vessel was filled with pure quartz as the rooting medium, the other with the iron-manganese 'frit.' The solution in the feed-vessel contained all necessary nutrients except iron and manganese. At the same times and in equal quantities each culture-vessel was temporarily flooded with the solution. This solution was allowed to run back into the feed-vessel after each seven-minute flooding. Plants growing in the frit-filled vessel did not develop iron or manganese deficiency symptoms, but plants growing in the quartz-filled vessel did.

At first sight it might seem that the iron and manganese in the frit had entered the solution sufficiently to feed the plants. But this is not a tenable theory for if solution had taken place the frequent returns of the solution to the main feed-vessel would have led to its enrichment with iron and manganese so that eventually the plants in the quartz-filled vessel would also have received these two nutrients. It has to be assumed, therefore, that the plants with their roots held in the frit obtained their iron and manganese by direct contact and without the intervention of a solution process. The implications of this work will perhaps not surprise observant growers or gardeners. How often when a pot-raised seedling is transplanted the tenacious adherence

of small fertiliser particles to the roots has been noticed! Often, too, the particles are those of an insoluble fertiliser, *e.g.* bone meal. This, too, suggests that roots can obtain nutrients by direct contact.

Food production in Hong Kong

ONE of the brighter aspects of the present-day position in regard to food supplies was touched upon by Dr. G. A. C. Herklots, Secretary of the Colonial Agricultural Research Committee, in a talk recently delivered before the Nutrition Panel of the Food Group of the Society of Chemical Industry, in which he described the remarkable progress made since the war in developing food supplies in the British Colony of Hong Kong.

This tiny enclave in the vast expanse of Communist-dominated China provides an outstanding example not only of recovery in the post-war period but also of marked improvement on pre-war conditions.

We may perhaps remind our readers that Hong Kong comprises the island of Hong Kong itself, the site of Victoria, the capital city of a million inhabitants; the city of Kowloon, situated on a peninsula on the far side of the harbour with one and a quarter million inhabitants; and the so-called New Territories which include part of the mainland and numerous islands north of Kowloon with a total area of 355 sq. miles. The greater part of the colony is mountainous and barren, although in the New Territories there is some good land.

The colony exists principally by its activities as a port and its connected trade. There was some agriculture in the New Territories pre-war, mainly concerned with subsistence farming and the growing of vegetables for consumption in the cities; there was also a fishing industry of some size, but both fishing and vegetable growing were handicapped by the activities of the groups of Chinese ' laans ' or middlemen who constituted the only means for disposing of produce and who wrung the last cent to be squeezed out of the unfortunate cultivators and fishermen.

Before the war malnutrition and under-nutrition were rife in Hong Kong and the death-rate from beri-beri and other diseases of malnutrition was appallingly high. During the war the colony was overrun by the Japanese, and British officials who escaped death were interned. During their captivity a group of interned officials occupied themselves with working out plans whereby the fishing industry and the growing of vegetables could be placed on a better footing, when and if British authority was restored, by the better organisation of the marketing of produce.

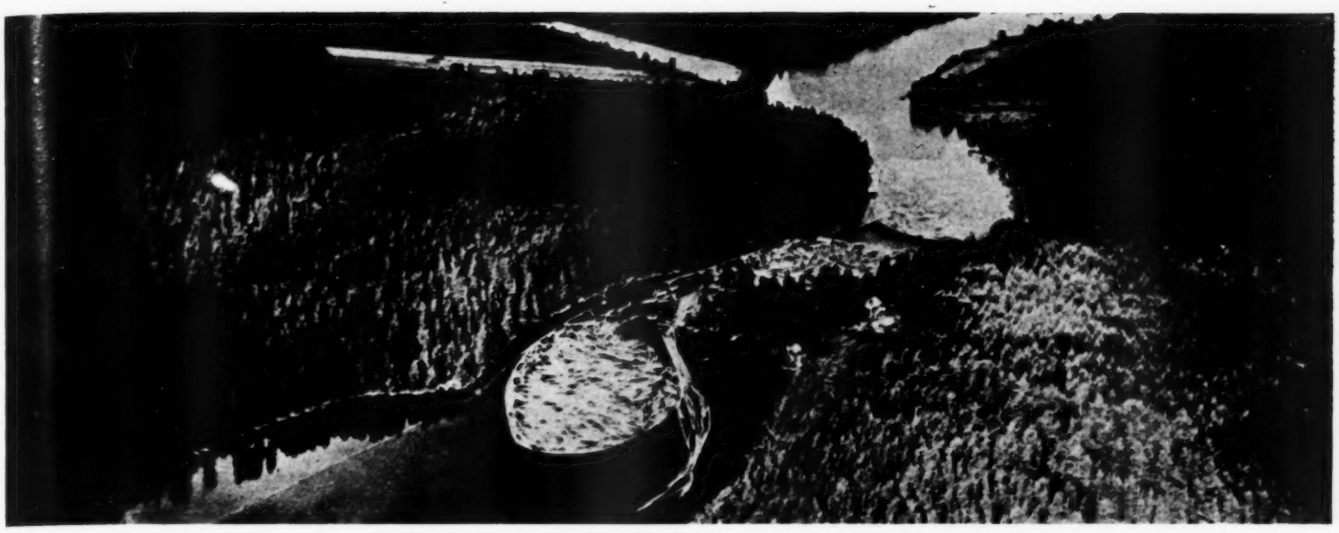
On the resumption of British control these schemes were put into action by the authorities, and in the interval have succeeded in transforming the situation. Thanks to orderly marketing on cooperative lines, the influence of the ' laans ' has been reduced to small proportions and farmers and fishermen have been able to make sure of receiving fair prices for their produce. Actually 75% of the vegetable requirements of the towns are now produced in the New Territories, while there has been a marked improvement in the health of the general population, which has been augmented by numerous refugees from Communist China. A number of factors are probably responsible, but among the most important is undoubtedly that as a result of these efforts a plentiful supply of fresh food is available for the first time to all classes.

It is noteworthy that in the section of the Hong Kong report for 1951 dealing with health matters it is recorded that ' *there was little evidence of malnutrition during the year as shown by the comparative absence of deficiency diseases.*'

Truly a remarkable result, but like many British efforts it will probably pass unnoticed or at best be submerged by one of those cataracts of a misrepresentation and abuse which at present are lamentable features in some countries where alien political creeds prevail. In our view, Dr. Herklots has rendered a notable service by calling attention to the matter as well as by the part he played personally in helping to bring about these developments.

British forests, present and past

MOST people know that the greater part of the surface of Great Britain was covered by forest less than 5,000 years ago, but not everybody grasps the full implication of the statement or knows that most of such regions as the Lake District, the north-east Yorkshire moors, the heaths of Norfolk and south-west Dorset (and for that matter the Quantocks, Exmoor and Dartmoor also) were tree-covered. In a recent lecture at the Royal Institution Professor W. H. Pearsall, F.R.S., referred to this and recalled that much of the waste moorland which now supports perhaps some sheep or one deer to every 30 or 40 acres had a much ' higher status of production ' and supported thriving human populations when it was still under trees. Ignorance on this subject is so general that contemporary attempts to afforest land in these areas (and most particularly the Lake District, the Quantocks and Dartmoor) are sometimes denounced as outrages, on the assumption that these have always been bare and open regions, and that trees must therefore be out of place. In fact, much land of this type which is now bare and unprofitable has become so, as Professor Pearsall said, because the destruction of the forest cover was followed by leaching or washing away of humus and essential minerals. He made a strong plea for re-afforestation, adding that in much of the poorer land of this island a beef-and-beer type of agriculture could never succeed. (Incidentally, the reports on the recent Lynmouth disaster mention the bareness of the inland watershed as a major contributory cause of the flood, and recommend that afforestation should have a place in the precautions against the recurrence of such floods in the future.) It is perhaps worthy of note that there appear to be no maps to show, and very few, if any, reliable accounts describing when and how the natural and semi-natural forests were destroyed in various parts of the country. The great extension of farmlands in Plantagenet times, house construction, shipbuilding, iron-smelting and glass-making, are well-recognised influences in the decline of British forests during the last 750 years, and it is also known that during the previous 4,000 years climatic changes and agriculture (which here includes grazing) from Neolithic times onward told against our forest, although many details and some major features of the story remain dim and vague.



Logs travelling from forest to sawmill in Finland by the old-age method of river transport

World Timber and Pulp—Requirements and Supplies

J. J. MacGREGOR, B.Litt., B.Sc., M.S.
Forest Economist, Imperial Forestry Institute

Among the many tasks assumed by FAO have been efforts to improve and stabilise world supplies of timber and wood pulp for paper making. In this paper the author outlines the organisational steps that have been taken and reviews the salient points in the position ruling at the beginning of 1952.

AMONG the legacies of the Second World War in Europe were the many difficulties which arose in the spheres of production and trade. Numerous organisations, commissions, and committees have been set up to bring order out of chaos and to reduce the worst effects of the shortages which accompanied and followed hostilities. Timber and timber products, including wood-pulp and newsprint, were among the vital raw materials of which supplies were, and still are, below pre-war requirements.

According to the data published regularly by the Food and Agriculture Organisation, about one-third of Europe's land area is under forest and reckoned to be capable of providing annually about a cubic metre of timber per head of population. Although individual countries in Europe show wide differences in their consumption of timber per head, the amount available used to be regarded as reasonably adequate for normal requirements. But pre-war, Europe was not completely self-sufficient in timber and an import of about 500,000 standards was necessary to offset the amount exported. In addition, there was an export of pulp and paper equivalent to 12 million cubic metres of round timber. After the war the trade in timber recovered slowly. On the one hand a large increase in world prices, coupled with the need to exchange timber for other requirements, acted as an incentive to greater production; but on the other hand, many difficulties arose from shortages of foreign exchange, equipment and manpower. The buying countries attempted to make their purchases of timber as effective as possible by directing its use to essential purposes.

War and post-war positions

During the war, and until the end of 1945, the Combined Board in Washington was responsible for the allocation of timber. In the early post-war days the Emergency Economic Commission for Europe (EECE) set up a Timber Sub-Committee to allocate peacetime supplies, while the Food and Agriculture Organisation set up a Forestry and Forest Products Division which has since been exploring ways and means of meeting the timber shortage problems in many parts of the world.

In addition to its headquarters' staff, FAO has three Working Groups—for Europe, Latin America, and the Far East There is also a standing Advisory Committee on Forestry and Forest Products, and five technical sub-committees.

Activities of FAO

The activities of the Food and Forest Products Division of FAO have been concerned with the selection of the more urgent and feasible projects, with methods of increasing timber supplies and meeting national requirements, and the provision of essential services. Funds were limited, and the tasks undertaken had to be carefully selected. Many of the difficulties of timber supplies are associated with unequal distribution throughout the world. In countries where the level of consumption is high, as well as in poorly developed countries, an increase in demand was expected if the aim of raising living standards was to be achieved. It was thus one of FAO's main tasks to assist expansion of timber production to meet prospective increases in demand. Three ways of achieving this have been explored: (*a*) reduction of waste; (*b*) the more effective management of existing forests; and (*c*) the development of new forests.

Improved methods of forest utilisation would, it was hoped, double the forest output without making further encroachments on growing stocks. A similar doubling of production was expected from improved methods of forest management

and the development of previously inaccessible forests. It was reckoned that so far only about one-third of the world's forests were being developed, and the standard of management was far from adequate. The creation of new forests was expected to bring many direct benefits, apart from additions to timber supplies, such as the restoration of soil fertility, the maintenance of water supplies and the prevention of soil erosion.

So far, several countries have received advice on protection, organisation for handling fires, and controlling attacks of insect pests. Studies have been made of more rational use of wood and the employment of new techniques. The need of specialised types of machinery has been analysed and the availability of equipment from manufacturing countries explored. Two methods by which yields have been increased are (1) through the technical advice of special missions, and (2) through the so-called ' timber equipment projects,' of the ECE Timber Committee in conjunction with the International Bank. The essential idea of the latter is to enable exporting countries to purchase efficient machinery through loans linked with contracts from importing countries to take agreed quantities of timber and to pay for it in dollars over a minimum number of years. In this way Yugoslavia and Finland have each been granted loans of $5 million, and large increases in production are expected from them.

Another aspect of the work has been the provision of information on mechanisation and improved techniques; for this, information has been collected from over 2,500 firms. Particular attention has been given to extraction, loading and transport of timber, fire fighting, nurseries and sawmills. It is also hoped that international arrangements can be made for the certification of the origin and quality of forest seeds, and the acceleration of plant quarantine procedure. The possibility of creating integrated forest industries in certain parts of the world has also been explored, and FAO has shown readiness to provide technical missions to assist this if requested to do so.

1949 timber conference

The third method for increasing forestry production combines the long-term aims of raising timber production with rendering other benefits to the areas concerned. The afforestation and reafforestation of lands subject to avalanches, torrents and erosion are examples of this method. In certain regions, particularly those bordering the Mediterranean, there is also need to introduce tree-growing because existing timber resources are far from adequate for local requirements.

It is fairly clear that the main problems can most effectively be tackled regionally. To meet the problem created by European shortage of timber FAO in 1949 called a conference of 27 European nations in Czechoslovakia. The problem was responsibly faced by the producing countries, who agreed to step up production to 10% above what was originally planned. At the conference it was also recommended that plans for full-scale afforestation should be put into operation to counteract the extended fellings.

A log chute used in the mountainous country of Bavaria

According to the programme for 1950, the European Commission on Forests composed of representatives of European Governments, is primarily concerned with the development of regional forest policies and will study and make recommendations on questions of regional importance, including the management of privately owned forests, the securing of efficient forest output, international cooperation in fighting forest pests and the improvement of statistical information.

Other commissions

Similar commissions have been set up for Latin America and the Far East, and there is also a sub-commission on Mediterranean problems which, in particular, will study means of harmonising forestry and grazing, the identification of areas which should be planted, and the species and techniques best adapted for use under Mediterranean conditions.

Work of the ECE Timber Committee

The Timber Committee of ECE has made studies of the timber problems of the different European countries. To avoid duplication liaison has been established between it and FAO. The supplies and needs of the individual nations are reviewed at periodical meetings; especial attention is given to principal requirements, such as sawn softwood and pitprops; and Governments are advised about the changing situation.

Shortages of timber in post-war Europe were aggravated by exchange difficulties and the desire of exporting countries to be paid in hard currencies. The ECE Timber Committee helped to smooth out some of these difficulties by exploring methods of satisfying needs for equipment and by drawing attention to the possibilities of credit from the International Bank. Shortages of structural timber were caused to some extent by diversion of wood to competitive uses. ECE made a close study of this and the relationships between supplies of timber pulp and pitprops, while an investigation into economies in the use of timber was organised jointly by FAO and the Housing Sub-Committee of ECE.

The Marshall Plan and OEEC

Shortly after the establishment of ECE the joint recovery programme in Europe, associated with the Marshall Plan, came to be administered by the Organisation for European Economic Cooperation. The Timber Committee of OEEC then made studies of European timber requirements and also explored the possibilities of increasing supplies of tropical timber and reducing dependence on dollar resources. There is no official relationship between OEEC and ECE, although consultations take place occasionally between the two on technical matters.

The Point Four Plan

More recently, arising out of President Truman's ' Point Four Plan,' the idea of providing an expanded programme of technical assistance to under-developed areas has been associated with the forest policy of FAO. Under this programme an agreement has been entered into with Austria which includes the replanting of about 300,000 hectares and the development of roads and cableways to areas at present inaccessible.

Problems of the post-war era

The foregoing has described broadly the activities of the organisations associated with European timber questions since the

A pile of logs outside a paper mill. The conveyor towers can be clearly seen

war. It now remains to examine some of the actual problems of timber supply and demand.

Softwood supplies

The ECE Timber Committee recently estimated European import requirements of softwood at 3.3 million standards annually, and even with the purchase of about half a million standards from North America a gap of 400,000 to 800,000 standards might easily develop between potential demands and effective supply. These estimates can be seen in better perspective in relation to the position in 1950. Although in 1950 there was considerable competition for softwoods, an FAO Commodity Report stated that in the normal way a change towards a buyer's market might take place. This, however, did not materialise even though in the early part of the year the price rise was at least partly due to speculative influences. The Korean War led to stockpiling and concentration on rearmament, but through 1950 there was considerable building and industrial activity in Western Europe and in North America, until after the start of the Korean War. This was associated with competition for seasonal supplies of softwoods and was continued even in the face of sharply rising prices. At the same time production in France, Austria, Finland and Sweden was well above the level of 1949. 1950 was remarkable for an increase in timber imports and exports, and for a noticeable diminution of the U.K.'s trade with European exporting countries and a reversal of its timber purchasing policy in North America. European imports of timber from other areas, including the U.S.S.R., and exports to other areas were almost balanced, while the high demand for softwoods in South Africa and Australia stimulated export to these countries. The real balance, however, was achieved by relying on stocks and by using more hardwoods.

Britain's failure to purchase early in 1950 has been ascribed to misjudgment on the part of the U.K. Timber Control, which believed that by holding off purchases it would be able to secure supplies at more favourable prices later on. However, this proved a miscalculation because other northern continental countries purchased heavily to meet their requirements and to build up stocks. The situation in the U.K. was partly relieved by restrictions imposed in the United States to mobilise resources for the Korean War. These reduced demands for Canadian supplies, and in the price decline which followed the U.K. Timber Control was able to purchase large quantities at relatively low prices, although higher than hoped for earlier in the year. This price fall did not last long, however, and was offset by increasing freight rates.

All this pointed to a strengthening and maintenance of timber prices in 1951, and in Europe notably there was an unprecedented rise in price of 100% or more. In North America there was a decline in consumption due to the reduction in building which reduced the demand for softwood. Towards the end of 1951 a pronounced fall in general demand took place partly due to buyers' resistance to high prices. During 1952 trade in sawn wood showed a decline, consumption drawing on existing stocks, and by 1953 the situation is expected to be reversed and fresh supplies will be needed in most countries to satisfy current demands and to replenish stocks.

Supplies of pulpwood for paper

Supplies and requirements of pulpwood were surveyed in a study entitled *The Problem of Newsprint and other Printing Paper*, published in 1949 and prepared under the auspices of UNESCO by the Intelligence Unit of *The Economist*. This pointed out that a large proportion of the raw materials used in pulp and paper manufacture was produced and processed in North America, Europe and the Soviet Union. These three areas in 1937 produced 48%, 41% and 7% respectively of the total pulpwood output of nearly 100 million cu. metres. Canada supplied 40%, the U.S.S.R. 30%, Finland 16%, Austria 5%, Czechoslovakia 4%, and Poland 3% of world exports. Ten years later, in 1947, world production had increased to 111 million cu. metres, and in 1949 it was estimated to have reached about 130 million cu. metres. But the war had brought great changes in the main sources of production, the North American output having almost doubled and representing in 1949 about two-thirds of the world total, whereas Europe's proportion had declined until in 1949 it produced only one-third of the total. Sweden, the largest producer in Europe, reached her pre-war level, but production in Finland, Norway, Czechoslovakia, and Poland was much below it. Germany had been able to increase her output of pulpwood through temporarily overcutting her forests. The decline in consumption of pulpwood was greatly accentuated by the almost complete absence of Russian supplies. In 1949 Europe consumed less than one-third of the world's pulpwood production, as compared with a half in 1937. The French Zone of Germany has been an important exporter and contributor to the needs of other European countries in the post-war years.

The processed product of pulpwood is wood pulp—the raw material of paper and many paper products. Pulp requirements are associated with regions of high income per head, and are highest in North America and Europe. North America is the largest producing area and easily the largest consumer. Before the war Europe produced about half the world total; production after was about one-third. North America, on the other hand, before the war produced about 46% of the world total, whereas in 1949 production had risen to 65% of the total. Europe's share of world consumption fell from 42% pre-war to 29% in 1947. North America's share in the same period moved from 51% to 65%.

The reductions in European output have been most striking in some of the

countries with the largest pulp industries. Chief among the causes were the shortage of raw materials, due to reductions in imports or to over-felling of local sources, and to a lesser extent to the use of pulpwood for fuel and construction. The northern countries, besides suffering this kind of direct dislocation of their timber and general economy, had to contend with currency shortages in their European trade. Finland ceded the valuable timber lands of Karelia to the U.S.S.R. Although France, the Netherlands, Switzerland and Belgium had increased their pre-war level of production, in Europe as a whole pulping plant capacity to the extent of 2½ million tons was not being used in 1949.*

The U.K. and Germany, which were before the war the largest consumers in Europe, have suffered the biggest declines in pulp consumption; in 1949 the U.K.'s consumption was reduced to 60% of the 1937 level. Other countries where consumption declined are Finland, France, Italy and the Netherlands. On the other hand, Switzerland has more than doubled her pre-war consumption, and Belgium, Czechoslovakia and Sweden have exceeded their pre-war levels. Sweden is Europe's largest exporter of pulp.

International pulpwood trade

In international trade Europe is still the most important exporter of pulp and more than a third of its total goes overseas. North America is a net importer of pulp, and the pulp imports of the rest of the world, amounting in 1949 to about 400,000 tons, were met very largely from Europe and mainly Scandinavian sources. The Scandinavian countries and Canada supply about 90% of the world pulp exports, the other chief exporters being Austria, Germany and Czechoslovakia. The United States takes most of the Canadian exports and is with the U.K. responsible for importing over 60% of the total world's exports. France, Belgium, the Netherlands, Italy, Brazil and Argentina are the other main importing countries.

In 1951 world exports were estimated by FAO to be about 6.2 million tons, or 0.3 million tons less than in 1937; the 1949 figure was 4.9 million tons. This shows a steady recovery over the past three years. Compared with 1947, Scandinavian exports had fallen in 1951 from 4.6 to 3.8 million tons. Canadian exports had increased from 790,000 tons to 2 million tons. In 1948 U.S.A. imports were reduced by only 10% to 2 million tons, but imports of the rest of the world were down by nearly 40%. The chief sufferers in this sharp decline were Britain, France and Japan. The UNESCO report drew attention to the fact that this shrinkage of the world trade in wood pulp has been associated with the elimination of a free world pulp market.

An interesting feature of the printing paper and newsprint industries is that while printing paper production is widely dispersed throughout the manufacturing countries of the world, four countries—Canada, U.S.A., the U.K., and Finland—represent two-thirds of the world newsprint capacity. A very large proportion of the newsprint output enters into international trade and more than 80% of Canadian and Scandinavian newsprint is exported. The world production of printing paper appears to have recovered from the disturbances of war. A partial explanation for this—which contrasts with the newsprint position—is that printing paper has a wider range of raw materials for its manufacture. Attention is drawn in the UNESCO report to the wide disparities of consumption of printing paper per head in the countries of the world. To some extent this is aggravated by high import tariffs.

Newsprint

The newsprint industry has many distinctive features: it is suited to large-scale mass production methods and requires heavy investment of capital; to ensure steady working it must be sure of a regular flow of its raw material; the need to ensure a steady market for the output has led to the use of long-term contracts between producer and consumer; another somewhat similar aspect is the interlocking of newspaper firms with the production firms to ensure a steady supply of even quality newsprint. Newfoundland, with Canada, produced about half of the total world production of about 9 million tons, and North American output exceeds 60% of total world capacity. European production, on the other hand, has fallen since the beginning of the war by about 1 million tons to less than 3 million tons, or from 42% to 32% of world capacity. Britain and Germany, the two largest newsprint producers in Europe before the war, have suffered the largest decline—Britain by one-fifth to 800,000 tons and Germany to about 300,000 tons, which at present makes her the fourth largest producer. The total Scandinavian output has declined by 10% to approximately 1 million tons. Finland, Sweden, Norway, the U.K. and France have about 70% of the existing European capacity.

The United States have benefited most from the world increase in newsprint production since the war—an increase due very largely to the increased output of Canada since declines have been registered for most other countries. Some idea of the differences in consumption of newsprint per head in a number of countries is apparent from the following paragraph (p. 56) of the UNESCO Report:—

' In contrast (to the very low consumption even in some European countries) the United Kingdom is selling each day one newspaper to every two of its 50 million population, and the United States, with much larger sized newspapers, sells one copy to every three of its 150 million population. Current per capita consumption is 36

Aerial picture showing densely wooded land, bordering the Saar River, in contrast to areas which have been clean felled

* *The Problem of Newsprint*, p. 23.

kilograms in the United States, 22 kilograms in Canada, 19 kilograms in Sweden, 18 kilograms in Australia and 12 kilograms each in the United Kingdom, New Zealand and Hawaii. Before the war the United Kingdom ranked first with a consumption of 26 kilograms per head, followed by the United States with 25 kilograms, Australia 23 kilograms and Canada 17 kilograms.'

The Report pointed out that consumption trends of printing material in Europe tend to be obscured by Government controls and rationing and by the rapid rise in prices. It was thought, however, that given a chance to assert itself freely, the demand in the Western European countries would at least revert to the pre-war amounts provided that the prices of newspapers, periodicals, etc., did not get out of line with the general run of prices and wages.

Conclusion

One of the conclusions drawn by the UNESCO Report was that in the long term there is an assured world demand for newsprint. Prophecy is difficult, but putting the various estimates together it seems reasonable to put the world demand by 1955 at 10 million tons. At this level the regional distribution would be approximately North America 5 million, Europe 3 million, Latin America 600,000, Asia 750,000, Russia 300,000, Oceania 250,000, and Africa and the Near East 150,000 tons. Thus, in a few years the world demand could exceed both current world production and full existing capacity to be put at 8 million and 9 million tons respectively. Even with the inevitable dislocation of war the Report suggests that at times newsprint is likely to be a scarce commodity in view of the steady upward demand. Greater freedom of international trade is essential if the most effective use is to be made of available supplies. In view of the foreign exchange difficulties, a decline in U.S.A. consumption would not necessarily release supplies to soft currency countries. Indeed, the currency problem might become even more severe if it was associated with an industrial slump in the U.S.A. The main conclusion, therefore, is that the newsprint shortage is but one aspect of the general problem of foreign exchange. The development plans for expanding the newsprint industry outside North America are likely to fall far short of the potential demand and shortages are likely to remain in the foreseeable future.

Clearing a comparatively young conifer stand in Southern France

Photos: Pp. 93-96, Timber Development Association, London. P. 97, French Embassy, London.

Western Samoa a Potentially Important Cocoa Producer

In July last Mr. D. H. Urquhart, formerly Director of Agriculture, Gold Coast, completed for the South Pacific Commission a survey on the possibilities for stepping up production of certain cash crops in South Pacific territories. In Mr. Urquhart's opinion Western Samoa today offers more promising prospects for increasing cocoa production than any other cocoa-producing country in the world. His reasons for this finding are given in the following extract from his report to the Commission on the propagation and selection of cocoa material in Western Samoa:

There is little doubt that a survey of cocoa plantations would reveal that there are trees of high-yielding capacity to be found. A survey of plantations in Trinidad discovered trees of outstanding merit; and also showed that a high proportion were 'passengers' which gave little or no yield, while demanding the same attention as the more profitable trees. The average yield per acre of cocoa in Samoa is about four times that of Trinidad, and from this it can be assumed that the average yielding capacity is high and that there must be some particularly high-yielding trees.

A modern method of vegetative propagation is by rooted-cuttings, which provides for the vegetative multiplication of selected trees in unlimited quantity. The vegetatively produced material reproduces the qualities of the parent plant, while this is of course not true of hybrid seed.

The advantage of this rapid production of selected material is that it can be used with confidence for new planting, and can also be used for replacement of unprofitable trees. The possibilities of raising the yield of cocoa in Samoa by these means are enormous. It is the quickest method by which the country could substantially increase its income from export crops.

The choice of trees for multiplication is based on several factors, apart from high yield, and one of the most important of these is resistance to disease. The New Zealand Reparation Estates have noted a tree which shows remarkable resistance to *Phytophthora*. As this disease causes considerable reduction of the crop in Samoa and is responsible for serious reductions in the crop wherever cocoa is grown in the world, the importance of discovering a tree which is resistant to *Phytophthora* cannot be over-estimated.

It is possible that this tree (named Lafi 7 by N.Z.R.E.) may be capable of transmitting its disease-resisting quality through its seed, and this is now being put to the test by the Estates. It is almost certain, however, that this quality could be retained in material vegetatively propagated from Lafi 7.

Samoa thus has cocoa material that is high yielding, and the possibility of combining this quality with *Phytophthora*-resistant trees. This opens up for Samoa a more promising prospect for increasing cocoa output than is available in any other cocoa-growing country today.

African Plants for Australia

Officers of the C.S.I.R.O. recently conducted an extensive plant collecting expedition through Africa and the Mediterranean region. They were searching for new pasture and forage grasses suitable for introduction into Australia, and for new varieties of crop plants such as sorghums, cottons, tobacco and groundnuts capable of acclimatisation to Australian conditions. Over 1,000 species and varieties were collected and these are now being planted and acclimatised. The process of introduction is slow and results will not be known for some years.

Agricultural Possibilities of Morocco

C. H. BROWN, B.Sc.

Late of the Egyptian Ministry of Agriculture

Readers will recall the series of articles on the Cotton Industry in Egypt contributed to WORLD CROPS *by Mr. C. H. Brown. He is now an adviser to the French Cotton Research Institute and recently visited Morocco in this capacity. In the following article he records some of his impressions of agriculture in that comparatively little publicised region.*

MOROCCO is a large country, very nearly twice the size of France. Yet very little has been heard of its agriculture, which up to now has been dominated by a lack of water. Consideration of the country's possibilities naturally subdivides itself into three great areas: the mountains, the plateaux, and the plains.

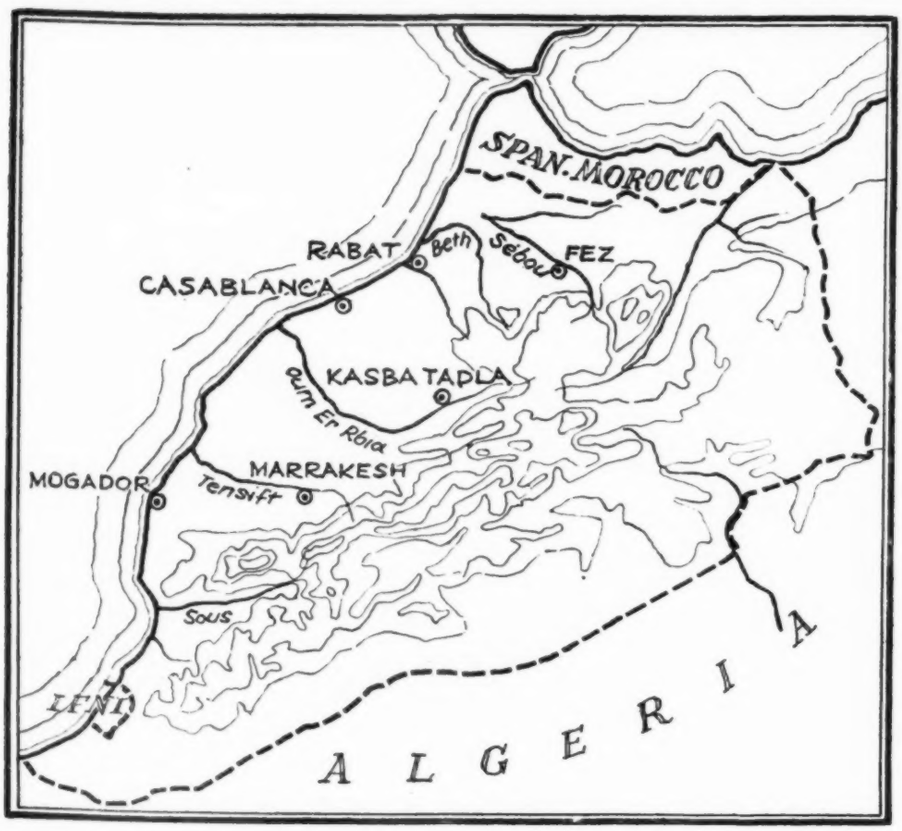
The central Atlas range, which cuts across the north-west corner of Africa, rises to peaks of a maximum height of 12,000 ft. and is flanked by the minor ranges of the Anti-Atlas, facing the Sahara, and the Middle Atlas, facing the main Moroccan land mass. Agriculturally their main interest is that they are the source of the few relatively small rivers that the country possesses.

The central plateaux

The vast central areas of Morocco are the dry plateaux, which vary from high and rocky land to the relatively fertile lower slopes. In the high areas wheat or barley are the standard crops. Sown in the autumn, their success depends on the abundance or otherwise of the winter and spring rains. There is no attempt at rotation, the same cereal crop being grown each year, but a dry farmed maize crop is sometimes taken after the wheat crop. It is usually poor, since the summer and autumn rains in Morocco are light and independable, although an unusually good rain in September, of course, helps the crop, and farmers apparently think the possibility of this justifies the work involved in sowing maize.

The lower slopes of this region with the deeper soils are the traditional vineyards of Morocco and the wine production has quite a good reputation for local consumption, although it is hardly known on the international markets. These plateaux carry a small animal population: sheep, goats, donkeys and a few undersized cattle. Scattered wells are dug to water them in the summer, and a common sight at this time is a group of animals standing round the well, waiting for the water, drawn up by hand, to be poured into a trough. The scene forcibly recalls biblical memories.

They are actually too high to be irrigable; but there would not be enough water available in Morocco to enable these extensive dry areas to be irrigated, even if it could be brought to them. One is therefore reluctantly forced to the conclusion that in the present climatic conditions there is little that can be done to improve them and we are left with the feeling that the agricultural future of Morocco lies mainly in the plains, small as these are in relation to the total area of the country.



The plains

The plains comprise a number of first-class alluvial soils, and, given serious attention, are relatively easily irrigable. They are each served by a small river which laid down the alluvium in the days when the country had a much bigger rainfall than it has today. Although these rivers are small, they are big enough to provide all the irrigation water required, and their passage through the steep mountain valleys makes the task of damming them a fairly simple one.

In a number of plains development lies in the more or less distant future, but in three of them engineering works are already well in hand. These are the Sidi Slimane district in the north, watered by the river Beth; the Doukkala district on the coastal plains south of Casablanca; and the Tadla plain lying just under the shadow of the Middle Atlas range, in central Morocco. The two latter plains are both on the same river, the Oum el Rebia, the largest in Morocco. Of all these plains that of Tadla is the largest, the total irrigable area there being estimated at about 250,000 acres.

Irrigation development

It is at Sidi Slimane, where the dam is in full working order and irrigation development is furthest advanced, that we can best see the probable pattern of the future. Land owners have usually started by planting orange groves, and the earlier, now fully-grown plantations, bordered with tall cypress wind-breaks, made it already seem like a second California in miniature. The trees present a striking picture of health, and in fact the crop has been so

Modern concrete irrigation canal in the Gharb Plain

Restoring the soil in the Sidi Slimane district by contour irrigation

Cotton Research Station, in the Tadla Plain

uniformly successful that more and more new groves are coming into being. This has alarmed the more far-sighted planners and considerable thought has been given to possible alternative crops which could lessen the dependence of the region on the market for oranges.

Alternative crops

Tobacco. Tobacco has been extensively planted here and in other parts of Morocco and enough tobacco is already being grown to supply the country's whole needs. The possibility of an export trade is now being seriously considered. The production of types of tobacco suitable for the international market presents certain technical difficulties, as was the fact in other countries such as Greece, and the possibilities must be treated with reserve until they have been proved.

Cotton. Cotton is also being studied. It is not a new crop in Morocco, some cotton having been grown there for many years; but it is only now that the problems are being studied seriously, having regard to the much larger irrigated areas likely to become available in the future. The *Institut de Recherche du Coton et Textiles* has now set up a central research station in the Tadla plain, and a series of co-ordinated, varietal and cultural experiments is already under way. In view of the general similarity of the climate to that of Egypt, Egyptian type cotton is being grown, and so far cultivation is based on a Pima strain introduced many years ago. There is naturally no evidence that this is best adapted to the conditions, but the point will doubtless be cleared up in due time, and as in other cotton-growing countries, local selections of hybrid origin will probably provide the varieties of the future.

Cultural methods

A study of the cultural methods used immediately demonstrates the big advantage which Egypt enjoys through the existence of long-established agricultural practices and the duties which have become second nature even to the uneducated peasant. Morocco, on the other hand, has not only to think out for herself the best time for sowing, spacing, etc., but also to get them generally adapted by the growers, which is a much more difficult problem. It will take time, but there seems reason to hope that ultimately the difficulties will be successfully surmounted and valuable cotton crops grown. The unlimited market for the right types of cotton should make its disposal easy, and the central question is likely to become the economic competition between cotton and other crops.

Discordant races

From the social point of view there is some discordance between the points of view of the French settlers and the native population of Arab or Berber origin. The latter tend to work their small plots with their own hands, and are therefore less immediately aware of the costs of production problems that pose themselves more clearly to the larger landowner employing paid labour. It is often, as a result, believed that crops like cotton are of interest more particularly to the small man.

In the Tadla plain, which is provided with irrigation deriving directly from the river, large areas are already cultivated in the officially organised land settlement project known as the Beni Amir scheme. The main layout of this scheme is provided by the organisation; under it whole tribes, hitherto landless, have been encouraged to settle *en bloc*. It is from this area and the few isolated plantations, irrigated by pumps, of the French settlers, that the capacity of the whole of the region for agricultural development can be fairly estimated. At present, as part of the irrigation development, a dam up in the mountains is under construction, from which a seven-mile tunnel will bring water through the Middle Atlas range to the plains.

Wheat growing

Where wheat is at present grown in this region it is, like the plateau crops, dependent on the sparse winter rains. With full irrigation available there seems no reason why the Egyptian practice of growing irrigated wheat after cotton should not be followed. There is likely to be a place in the rotation also for Egyptian berseem (*Trifolium alexandrinum*); this is under trial in a small way but has not yet played any notable part in Moroccan agriculture. Lucerne, maintained for two years, is at present considered the most promising fodder.

Conclusion

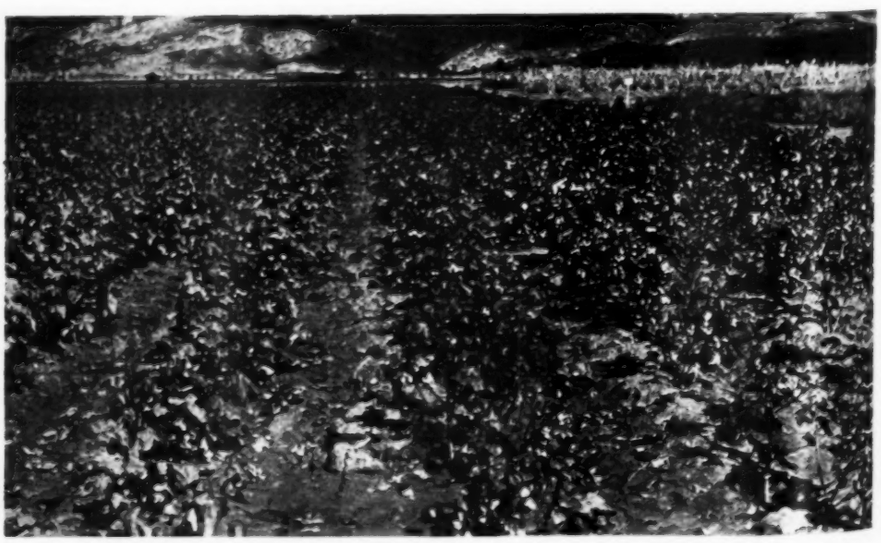
The general picture of Morocco is of a country basically Arab in nature, the agricultural possibilities of which are being developed by French organisations employing modern methods, notably planned irrigation, the possibilities of which would otherwise have remained dormant. For some decades to come, at least, Morocco therefore appears to be in the happy position of being a country of which the resources, so far, are largely unexploited and are well in advance of her actual present needs.

Irrigation canal near Beni-Mellal; note the well-constructed take-off channel on right

The fellah adapts himself quickly from the sickle to the reaper and binder

Photos: Pp. 99 (top two) and 100 (excl. bottom right), French Embassy, London.

Harvesting in an orange grove of the Sidi Slimone district



Experimental plots of irrigated cotton; Atlas Mountains in the background

Grazing pigs on a pasture of crimson clover (trifolium incarnatum) in the Southern States, U.S.A.

Legumes in Tropical Agriculture

R. O. WHYTE, Ph.D., B.Sc.
Food and Agriculture Organisation

Ever since the introduction of red clover and other legumes revolutionised crop rotations and farming systems in Western Europe and Great Britain, the numerous genera and species of the Leguminosae have been the subject of research and discussion. Much has been said regarding the value of legumes in rotations or for green manure and on the need for a 'white clover' for the tropics, but no attempt has yet been made to include under one cover our present state of knowledge and experience on legumes in all their aspects and under all climatic conditions. FAO has, however, now made a special study of these questions and has reviewed them in an Agricultural Study entitled 'Legumes in Agriculture,' to be published shortly. Meantime, Dr. Whyte has prepared the following outline account of the subject.

LEGUMES have been grown as crops for at least 6,000 years. The lake dwellers in Switzerland, 5000 to 4000 B.C., apparently cultivated a few plants including peas, and added a dwarf field bean during the Bronze Age. Chinese literature records the cultivation of the soybean between 3000 and 2000 B.C. Legumes featured in the cropping systems of the early Egyptian dynasties, and later in the Roman era several writers stressed their value for food and soil improvement. American Indians have from the earliest times raised beans among their maize, and beans also form an important part of the indigenous diet in Latin America.

Botanical characteristics

It is well known that the flowers of the sub-family *Faboideae* (beans, peas, vetches, clovers, lucernes) have the 'butterfly' shape, the flowers of the *Caesalpinoideas* are irregular and appear in comparatively loose racemes or clusters, while the regular flowers of the *Mimosoideae* are usually collected in dense heads. Because the staminal sheath in the 'butterfly' flowers encloses the pistil, and the keel encloses both stamens and pistil, it is usually necessary for the keel to be sprung or tripped by insects as the agents of pollination. The seed pods are characteristic of the family, sometimes straight and long, or jointed or constricted between the seeds, or wound in a spiral.

The leaves of the true clovers are compound, divided into three leaflets (trifoliolate) generally with short stalklets (petiolules) of equal length. Species of *Medicago* and *Melilotus* have similar leaves, but the central leaflet is borne on a longer petiolule than the lateral ones. Most other legumes have leaves with more than three leaflets, or are bipinnate as in many tropical trees.

Two types of germination occur: (1) epigeal, in which the cotyledons, usually enclosed within the seed coat, are pushed above the soil surface by the rapid elongation and straightening of the hypocotyl (*Mimosoideae*, *Caesalpinioideae* and some tribes of *Faboideae*), or (2) hypogeal, in which the hypocotyl elongation is limited, the cotyledons remain in position within the seed coat in the soil, and the epicotyl, more fully differentiated prior to germination, pushes up through the soil (some tribes of *Faboideae*); both types of germination are found in the *Trifolieae* and *Phaseoleae*.

The nodules

Frequently within a few weeks after germination, bacteria of the genus group *Rhizobium* enter and infect the root through the root hairs. The nodule bacteria are carried considerable distances in dust or through the air, on the surface of seeds or in water. Infection of the root can take place within a few hours, only a relatively few points of infection being necessary. The significance of the symbiotic nitrogen

fixation which ensues is the subject of a special chapter in *Legumes in Agriculture*, covering the function of the nodule, the bacterial genus *Rhizobium*, species relationships and cross-inoculation groups, effective and ineffective nodulation, the sequence of developmental changes in the nodule throughout life, some factors affecting nodulation and nitrogen fixation, the artificial inoculation of legume seed, and some examples of legume failure related to symbiotic nitrogen fixation.

Ecological relationships

The ecological position of legumes deserves investigation, as it may provide a basis for evolving improved systems of grazing or the ecological management of natural vegetation. Most pasture or crop legumes suffer a great deal of defoliation by grazing or cutting, and the humid temperate lands are fortunate in having a few legumes such as *Trifolium repens* and possibly *T. subterraneum* which are stimulated by controlled but quite heavy grazing, if an appropriate nutrient and lime status is maintained in the soil.

On the other hand, there are the leguminous species which occur in small percentages in climax grassland of the range, steppe or pampas type, or in tropical and subtropical associations. With a few possible exceptions these are eradicated rather than stimulated by anything except very light grazing and have little potential value. There is no indication yet of the existence of a white clover for the tropics, or of a legume which will grow and retain its position in association with tropical grasses under relatively heavy grazing. The trend may be rather towards the cultivation of arable legumes in separate plots alongside natural grassland areas or a cultivated grass crop, to be grazed or more probably cut and mixed for feeding after harvesting, to raise the average protein level of the fodder.

A third group of leguminous species adapted to thin, dry, eroded soils seems to come in when climax grasslands have been subjected to excessive grazing. These are generally unpalatable because of their composition or spiny habit, but are able to survive in semi-arid and sometimes alkaline conditions, and can become dominant over considerable areas. There has been a tendency to attempt to utilise some of them for fodder to meet the needs of a low-grade animal husbandry, but it is now realised that the correct course is, wherever possible, to adjust the vegetation by ecological management so as to eliminate the undesirable species and favour a return to higher and more valuable types of vegetation.

Soils and soil fertility

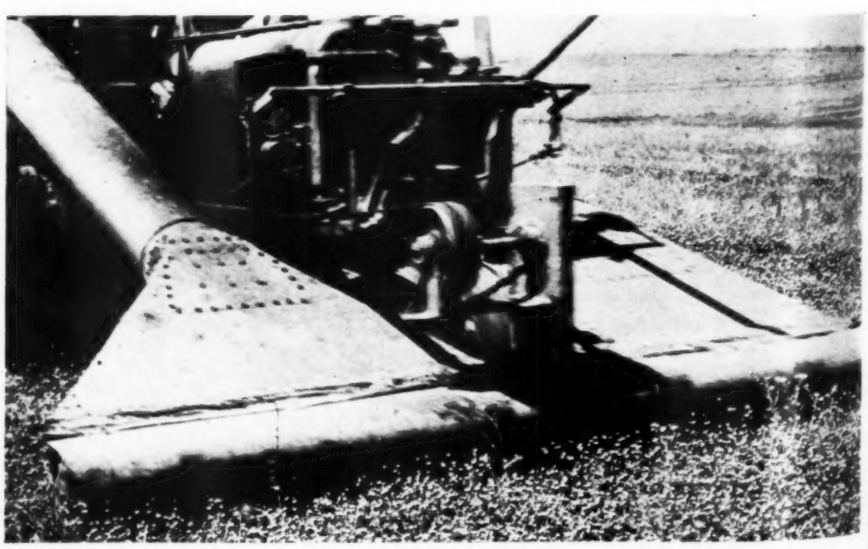
Soil affects legumes and legumes influence the soil. Factors of particular importance to legumes include capacity to hold and release water and oxygen to the plant, the acidity or alkalinity of the soil, its content of nutrients, and the absence of toxic substances.

Soil reaction appears to govern the distribution of certain legumes, but acidity and sourness are often confused with the supply of available calcium as a nutrient. The apparent need for lime of legumes such as lucerne and other medicks has sometimes led to an erroneous emphasis on soil alkalinity rather than on the presence of calcium as a nutrient.

Apart from nitrogen, the nutrients required by legumes are phosphorus, potassium, calcium, magnesium, iron, sulphur, copper, zinc, manganese, boron and molybdenum. Considerable emphasis is placed in Southern Australia on the last five trace or minor elements. Molybdenum is required at rates of 20 to 30 gm. per hectare for N-fixation. Manganese, copper and zinc tend to become more available with increasing acidity, and molybdenum with alkalinity. In Australia the calcium and sulphur in superphosphate have great significance, since the sulphur required in the elaboration of nitrogen into sulphoproteins is deficient in many Australian soils.

Much is already known about the use of leguminous crops in fertility-restoring farming systems in temperate lands, and the relation between the method of utilising the top growth and the after-effect obtained. The principles which apply to tropical and subtropical conditions are not yet so clear. Although technical agriculturists in these regions recognise the value of legumes as a source of protein and as improvers of soil fertility, economic and social influences frequently prevent their wider use in farming systems other than plantation agriculture. Subsistence farmers with restricted acreages cannot afford to release much land for the cultivation of a green manure crop which does not give food or a direct economic return. When ample land is available, peasant farmers prefer to practise shifting cultivation as a method of restoring soil fertility rather than adopt farming systems based on what are generally assumed to be desirable rotations of legumes and other crops. As pressure on the land increases the objective of land-use planners should be to ensure that the farmer has sufficient acres to operate his farm as a balanced holding, *i.e.* he should be able to make a reasonable living and at the same time devote some of his land to a fertility-restoring break based on legumes with or without livestock. Complete integration of crop husbandry and animal husbandry may be desirable, but is not, however, always possible.

Legumes improve the soil by raising its nitrogen and organic matter status, by bringing up minerals through their root systems from the lower soil horizons, and possibly by improving soil structure. But their most important attribute in tropical and subtropical countries is the provision of adequate protection for the soil against sun and rain. The primary objective of farmers should be to avoid exposing the soil to these destructive influences for anything beyond a minimum period of time. Once this need is met, one might well expect tropical legumes to play their usual role of influencing soil fertility.



Home-made suction machine for harvesting Ladino white clover in California

Workers in the Belgian Congo and certain other parts of the tropics of Africa and South America doubt whether legumes are really as valuable as generally thought and find that the ordinary bush fallow, grass fallow or *Pennisetum purpureum* have as good an effect on soil fertility as do legumes, or even better. One can only speculate on the reasons for this.

In heavily leached soils the root systems of legumes may not be able to perform their normal function of reaching down through the soil to bring up the minerals required to enrich the topsoil. The ploughing-under of shallow-rooted green manure legumes under such conditions in the absence of fertilisers may merely serve to widen the ratio between nitrogen and the other plant nutrients. On the other hand, the shrubs and small trees of the bush fallow probably do reach below the leached soil horizons, and so the burning of their top growth prior to a new cropping sequence will provide a top-dressing of mineral-rich material on the soil. This may explain the good results obtained with a deep-rooted leguminous shrub like *Leucaena glauca*.

Tropical kudsu (Pueraria phaseoloides) in Puerto Rico

The superior after-effect of a grass fallow and particularly of *Pennisetum purpureum* may presumably be associated with increased organic matter and improved soil structure, as indicated by the work on elephant grass and soil structure in Uganda.

The response of different soil types to bulky manures, including green manure legumes, was discussed at the second meeting of the FAO International Rice Commission at Bandung, Indonesia, in May 1952. This meeting agreed that the importance of green manures for increasing rice yields could not be overemphasised. Evidence from Indonesia and India suggested that green manures are more effective for paddy fields than ammonium sulphate. This was attributed variously to nutrients other than nitrogen in the green manure, and to the greater reducing capacity of water-logged soils in the presence of additional decomposing organic matter, causing an increased rate of release of phosphate from ferric combination.

Cowpeas (Vigna sinensis) growing between rows of Napier grass (Pennisetum purpureum) at Rietvlei, Southern Rhodesia

An interesting comparison between legumes and non-legumes for green manure was reported to this meeting. *Crotalaria usaramoensis* was compared with *Eupatorium pallescens* and *Tithonia diversifolia*, both non-leguminous shrubs. All gave good responses when applied at 25 tons per hectare on paddy fields, but the nitrogen content of the non-legume, *Eupatorium*, was higher than that of *Crotalaria*; it would be interesting to compare the spread of the root systems of these species, and particularly their respective depths in relation to the mineral content of their above-ground portions.

Pastures and animal feeding

The use of legumes as key plants in the form of alternate husbandry known as 'ley-farming' is largely confined to countries with a long growing season, a temperate climate and a well-distributed rainfall, or a drier, hotter climate with ample water for irrigation. It is doubtful whether countries which cannot reproduce these conditions can operate ley farming in the restricted sense, entailing the maintenance of the complete fertility cycle of soil/herbage/animal/soil in a period of pasture years with periodic breaks for the cultivation of cereals and other cash crops.

There are many forms of alternate husbandry in the tropics, from the Indian systems incorporating a grain legume for a period of as little as seven or eight weeks to the long-term grazing or fodder mixtures attempted in other tropical countries. Workers in tropical countries are evolving different techniques in the establishment of sown pasture. There are, for example, those who are attempting to reproduce under tropical conditions something approaching the mixed legume/grass stand characteristic of sown pastures in humid temperate regions. There are others who do not consider this possible in tropical climates or with species of grasses and legumes of incompatible growth habits and seasonal behaviour. They see greater possibilities in the cultivation of tropical grasses and particularly legumes in spaced rows rather than broadcast. One field may be sown entirely to a legume, possibly adjacent to another field of sown or natural grassland; alternatively, one may have seven or eight rows of annual legumes between rows of a perennial grass, or other such arrangements.

The advantages of row cultivation of lucerne and *Phaseolus lathyroides* in particular has been stated by workers in Queensland as follows:

(*a*) Establishment is more certain, particularly in weed-infested land.

(*b*) Total yield for a 12-month period is greater.

(*c*) Yield during winter is greater.

(*d*) Production during all months of the year is more uniform.

(*e*) Plants commence growth earlier in the spring.

(*f*) The life of the stand is prolonged because weeds can be controlled by cultivation.

Because of the low protein content of tropical grasses, wild or cultivated, legumes assume even greater importance than in humid temperate countries as a potential source of protein in the feeding of high-quality livestock, particularly of the dairy type. Work on animal nutrition in tropical conditions is still not sufficient for it to be possible fully to relate nutritional requirements to agronomic possibilities. Much work still requires to be done on the special significance of legumes in animal feeding, whether in the form of pasture, conserved fodder, grains or seeds, and the straw which is a by-product of grain cultivation.

High-quality livestock require a uniform high level of nutrition throughout the year, an objective difficult to achieve in monsoonal or other tropical climates with high peaks of herbage production followed by deep troughs through the long dry seasons. The production of green fodder under irrigation is an obvious method wherever it can be adopted, but fodder production has to compete with cash crops which are considered, frequently erroneously, to be capable of higher economic returns than high-yielding fodder crops would be if fed to good dairy cows yielding more than 3,500 to 4,000 lb. of milk per annum (an Indian example).

Many tropical and subtropical countries are overloaded with low-grade livestock which find most of their sustenance on areas flattered by the name of 'natural pastures.' It might theoretically be desirable to improve the quality of these natural grazing areas by introducing suitable types of legumes into them, but there is at present no indication that this is possible on any scale. Alternatively, one might plough and reseed certain areas to superior species of pasture or fodder legumes rich in protein, but this, even if possible, would not be economic in relation to the very low productive capacity of the livestock available to consume the fodder grown at considerable expense.

Plant introduction, breeding and seed production

Legumes have provided some outstanding examples of plant introduction in the history of economic botany. Some may be called adventitious or accidental, and include the gradual diffusion of a species along ancient and modern trade routes by land or sea, from one market centre to another, and from farmer to farmer. They have proceeded with invasions and general migrations of populations and cultures, in the ballast of ships, in packing material, or in the fodder of camel caravans. In addition, there has been the intentional exploration and importation by crop introduction agencies of a new crop or variety, or a species in the natural vegetation from some other country or region with a similar environment.

The spread of lucerne around the world from its supposed centre of origin in the steppe districts with their continental climate and saline soils in western Asia, in and around the ancient land of Media, the south-eastern Caucasus and north-western Iran, is largely an example of accidental introduction. The spread of red, white and subterranean clover has been in general of the same type. Perhaps the outstanding examples of controlled introduction of legumes are the soybean and *Lespedeza* into the United States.

Importance of bacteria

One vital omission in the introduction of new legumes which has led to failure and unwarranted negative conclusions on the adaptability of a species is in connection with the nodule bacteria. In the introduction of subterranean clover into Australia it was a fortunate accident that appropriate nodule bacteria were inevitably carried with the seeds, since these are usually formed in close contact with soil containing these bacteria. Other legumes which produce seeds in pods with no chance of contact between seeds and soil may be introduced without the necessary nodule bacteria accompanying them, and false conclusions regarding adaptability will be drawn.

The introduction of tropical legumes from one territory for trial in another is still tentative and uncoordinated. There is no doubt great scope for development just as there is for the selection of strains for different conditions and types of utilisation from among the many tropical genera and species. For this it would seem desirable to attempt some classification or grouping of tropical legumes according to growth form, possibly on the lines adopted by the workers in the Kenya Department of Agriculture:

(1) Ground cover creepers:
Vigna gracilis
Teramnus repens
Teramnus labialis
Trifolium cheranganiensis

(2) Ground cover/bulk producing non-creepers:
Stylosanthes gracilis
Alysicarpus glumaceus
Indigofera endecaphylla
Indigofera subalata
Tephrosia holstii
Tephrosia linearis
Argyrolobium

(3) Bulk-producing creepers:
Vigna vexillata
Glycine javanica
Dolichos falcatus
Rhynchosia elegans
Rhynchosia usambarensis

(4) Bulk-producing non-creepers:
Medicago sativa

(5) Rapid-growing free-seeding plants for catch cropping:
Ornithopus sativus
Dolichos lablab
Trifolium incarnatum
Trifolium semipilosum
Vigna catjang
Medicago tribuloides
Medicago hispida var. *confinis*
Crotalaria intermedia
Lespedeza striata
Vigna oblongifolia
Melilotis alba

But many specialists who replied to the FAO questionnaire soliciting information on tropical legumes stated that, even if the limiting economic and social factors could be overcome and farmers could also be convinced of the value of legumes for soil improvement, the lack of adequate seed supplies would still be a great hindrance to the wide use of legumes. Seeds of most of the species which agronomists find to be of promise are not yet available to farmers in tropical countries in adequate amounts. Farmers are loath to grow seed crops of green manure and other legumes because of shortage of land or the low economic return. There would appear to be a need for private enterprise to explore the possibilities in this field, and to support the work of seed distribution at present the responsibility of agriculture departments and cooperatives.

Collaboration in research

In many aspects of the understanding and use of legumes, tropical countries are 100 to 150 years behind the humid temperate zones. If this leeway is to be made up some degree of collaboration between the various tropical territories would appear to be desirable. Research on legumes for fodder and soil improvement in the tropics must necessarily be at a disadvantage with regard to financial allocations as compared with that on the major food and cash crops. Collaboration and avoidance of duplication, and the sharing of research projects would lead to economy of effort and a rapid pooling of results, and so overcome the difficulties caused by restricted staffs and facilities. Some type of international working party on tropical and subtropical legumes might provide a basis for such a joint approach to the many problems requiring solution.

Melted sulphur pouring into a vat at Grand Escaille, Lousiana

Changes in the Fertiliser Industry of the United States

HARRY A. CURTIS

A Director of the Tennessee Valley Authority

Last June we published an abstract of a paper read before the British Fertiliser Society by Dr. E. M. Crowther, reviewing his impressions of the fertiliser position in the U.S.A., following a tour of that country. The following article, by a recognised American authority, serves as an interesting corollary to the previous one. Mr. Curtis is already known to readers of WORLD CROPS *by his previous articles on the Tennessee Valley Authority.*

THE fertiliser industry in the United States is at present undergoing a rapid and rather extensive change, both with respect to its products and its company membership. The old fertiliser industry, which for so many decades expanded by just doing the same thing on a somewhat bigger scale, is now undergoing a rather complete face-lifting operation, and when the operation is finished it will have quite a new appearance.

Early history

As industries go, the fertiliser industry has grown slowly in the past 100 years. Early in its development the industry took on certain characteristics that persisted almost unchanged for many decades. The general pattern of organisation and operation that prevailed for a long time was about as follows: raw phosphate was mined and beneficiated near the deposits in Tennessee and Florida by several of the larger fertiliser companies. There were never more than a few independent mining concerns, but the mining divisions or subsidiaries of the large fertiliser companies furnished not only the washed phosphate used by their parent companies but also offered phosphate for sale on the open market.

Superphosphate

With minor exceptions, superphosphate was, until recent decades, the only fertiliser ingredient manufactured by fertiliser companies. A majority of the large superphosphate producers manufactured the sulphuric acid they used, but many more concerns, in general the smaller companies, purchased both rock phosphate and sulphuric acid in the open market. A large segment of the industry, the so-called ' dry mixers,' bought superphosphate from the big producers. Most of the fertiliser used in the United States is ' mixed fertiliser,' containing various proportions of nitrogen, phosphorus, and potassium compounds. Nearly all the fertiliser companies, big and little alike, bought the needed nitrogenous and potassic ingredients of mixed fertiliser.

Aside from mining by a few companies, and superphosphate production by a considerable number of concerns, the main business of the hundreds of companies comprising the industry was the compounding and sale of hundreds of mixtures of fertiliser ingredients.

Such was, until recent decades, the make-up of the fertiliser industry in the United States. Some of the practices adopted by the industry were certainly inimical to its own interests; some led to prosecution by the Federal Government under antimonopoly laws; and some of the practices certainly did not serve the interest of the farmer in getting cheaper fertilisers.

The industry takes pride, justifiably so, in the fact that whereas it once produced ordinary superphosphate carrying less than

14% available P_2O_5 equivalent,* today most of the ordinary superphosphate made carries 18 to 20% available P_2O_5 equivalent. Also the industry takes credit, not wholly due it, for the fact that whereas mixed fertilisers once carried, say, only 12 to 14% total N, K_2O and P_2O_5 equivalent, today the total so-called plant nutrient content in mixed fertiliser is more apt to be in excess of 20%, and the old 'low-analysis' mixtures have disappeared from the market. It is also true that the retail price index on fertilisers has increased less than on most other supplies that the farmer buys. All these facts are to the good, but the present discussion is concerned with more basic and significant changes than these.

Recent improvements

The changes that have come about in the industry in the recent past, and are now going forward at a greatly accelerated rate, can be ascribed to several situations, amongst which the following may be cited.

There is a rapidly growing demand for fertilisers. This is due in part to the relatively high prices of farm products, but other factors are also influencing demand. The educational programme in fertiliser use in well-managed farm systems, promoted by such agencies as the U.S. Department of Agriculture, the Tennessee Valley Authority, the farm cooperatives, and the more progressive companies of the fertiliser industry, have been effective in demonstrating the value and role of fertilisers in farm economy. Fertilisers are now being used in increasing quantities on lands and on crops not previously fertilised. Pastures that were once relatively unproductive and grazed by inferior livestock are now showing astonishingly increased returns through use of better plant species, fertiliser and better livestock.

In response to this demand the production of fertilisers is increasing rapidly. New synthetic ammonia plants, new phosphate mining and beneficiation plants, new phosphatic fertiliser plants, and new potash mines and refineries are coming into operation.

The increase in fertiliser production in the United States is illustrated in the table at the bottom of cols. 2 and 3. (Data from various publications. Rounded numbers used.)

It seems doubtful that the goals set by the U.S. Department of Agriculture for 1954-55 will be reached, but there will no doubt be a large increase over the current production.

* In the United States 'available P_2O_5' is that soluble in neutral ammonium citrate solution as determined by a procedure standardised by the Association of Official Agricultural Chemists.

A fertiliser demonstration plot maintained for educational purposes by the Tennessee Valley Authority

New fertiliser plants

Several large companies not heretofore engaged in fertiliser production have recently built fertiliser plants. This in itself is a significant change, for most of such companies have well organised research divisions, whereas lack of adequate research facilities was characteristic of most of the old-line fertiliser concerns.

Another change in the situation is related to the supply of ammonia available for fertiliser manufacturing. During World War II the United States contracted for the construction of more than a dozen new synthetic ammonia plants to supplement the several already in operation in this country. One of the new plants was built by the Tennessee Valley Authority, one by an oil company, one by a coal company, and all others by companies already producing chemicals of various sorts. Significantly, none of the synthetic ammonia plants in existence prior to World War II was owned by a fertiliser company and none of the new plants was built by a fertiliser company.

Long before the war ended it became evident that the ammonia output of the old and new plants would not all be needed for the manufacture of munitions. Ammonium nitrate had not been used to any large extent before World War II, but, with the likelihood that large quantities of this material would be available for agricultural use after the war, both industrial concerns and the Tennessee Valley Authority turned attention to the problem of conditioning ammonium nitrate to render it more acceptable as a fertiliser. Two successful but not altogether safe procedures were developed and ammonium nitrate has become a widely used nitrogenous fertiliser. The Tennessee Valley Authority now uses a different and much safer process in its plant at Wilson Dam, Alabama, in which ammonium nitrate is crystallised from solution under vacuum.

A review of the synthetic ammonia situation near the end of the war made it appear probable that, once the demand for munitions ceased, there would be a greater ammonia production capacity than would be required by industry and agriculture for some years to come. This prediction proved to be wrong. After a short period of adjustment, all the old ammonia plants and nearly all the new ones were operating at capacity. In addition, new plants have since been built, other plants enlarged, and still others are scheduled for early construction. Significantly, one of the synthetic ammonia plants built since World War II is owned by farmer stockholders.

More concentrated superphosphate

Until recently the quantity of concentrated superphosphate (46 to 50% available P_2O_5) produced by the fertiliser manufacturers was very small relative to the quantity of ordinary superphosphate (18 to 20% available P_2O_5) produced. Today, the production of the concentrated material is expanding rapidly. At least three new factors are influencing this change. First, repeated increases in freight rates have enhanced the advantages of shipping the more concentrated material. Second, farmer education with respect to the economies of using more concentrated materials has created a demand that did not exist heretofore. (This applies not only to phosphate fertiliser but also to mixed fertiliser; the higher grades of mixed fertiliser cannot be formulated using ordinary superphosphate.) And third, the raw rock phosphate of Florida and the western states (Idaho, Wyoming, Utah, and Montana) carries small proportions of uranium. This can be recovered as a by-product in the production of con-

U.S. FERTILISER PRODUCTION 1940-55 (REAL AND ANTICIPATED)

Year	*Total fertilisers (tons)*	*N (tons)*	*Available P_2O_5 (tons)*	*K_2O (tons)*	*Total plant nutrient (tons)*
1940	8,656,000	419,000	912,000	435,000	1,766,000
1950-51	20,989,000	1,238,000	2,110,000	1,380,000	4,728,000
1951-52 (est.)	—	1,375,000	2,100,000	1,515,000	4,990,000
USDA goals for 1954-55	—	2,185,000	3,350,000	2,100,000	7,635,000

centrated superphosphate, but not when ordinary superphosphate is made. The U.S. Atomic Energy Commission is therefore encouraging the use of the process that permits uranium recovery. In 1935, about 7% of the available P_2O_5 in superphosphates was contained in the concentrated superphosphate. By 1950 the percentage had increased to about 15, and this trend continues.

Sulphur shortage

Another potent factor in chancing the fertiliser situation is the current scarcity of sulphur. This shortage seems to have struck suddenly and with unfortunate effects, but the fact is that sulphur production has lagged behind demand and, in retrospect, it seems that everyone should have seen the storm before it struck. At any rate, all industries using sulphuric acid suddenly discovered, a year or so ago, that there was not enough sulphur in the market. The Federal Government added sulphur and sulphuric acid to its list of commodities to be distributed only under allocation permits.

The acute sulphur shortage is a temporary situation in the United States and is already passing. New deposits of elemental sulphur have been discovered; recovery from natural gas has been stepped up; recovery from smelter fumes has been expanded; and a number of low-grade deposits of sulphur are being mined and processed. While sulphur or sulphuric acid from these new sources will relieve the shortage, nevertheless it seems almost certain that the prices for sulphur and sulphuric acid have advanced permanently to higher levels, thus making more attractive any process of fertiliser production that avoids or reduces the need for sulphur.

Phosphorus production

Another development in the situation is the rapid expansion of elemental phosphorus production by the electric furnace method. Several companies have recently built electric furnace plants. Very little of the phosphorus from this source, except that produced by the Tennessee Valley Authority, is as yet used in fertiliser production. But it seems likely that the current markets for elemental phosphorus will soon be saturated, and the producers will then turn to the less attractive outlet of fertiliser production.

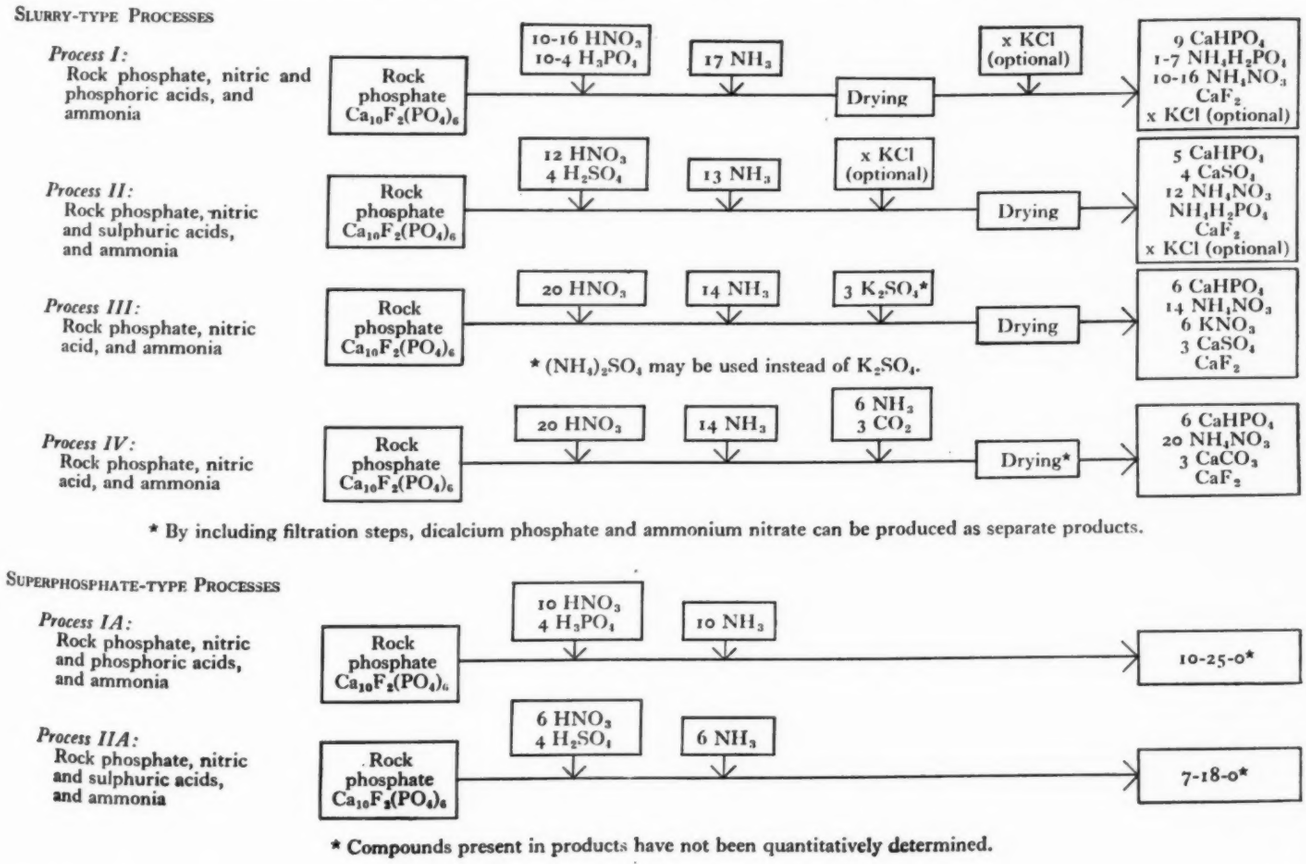
The current elemental phosphorus production capacity is approximately 200,000 tons per year and the trend is sharply upward.

'Nitraphosphate' processes

It has long been known that nitric acid could replace a part of the sulphuric acid used in making ordinary superphosphate or a part of the phosphoric acid used in making concentrated superphosphate. In the United States where, until recently, sulphuric acid was relatively cheap and abundant there was but little incentive to use nitric acid. The great expansion of synthetic ammonia production capacity incident to World War II, with consequent lowering of the market price of anhydrous ammonia, and, more recently, the shortage of sulphuric acid have made the so-called 'nitraphosphate' processes attractive.

Three or four years ago the Tennessee Valley Authority began research and pilot plant studies of such processes, some of which had been applied in Europe. At present, an association of farm cooperatives is building a plant to use one of these processes, and several industrial concerns are considering the construction of plants to use a nitraphosphate process. Indications are that the several variations of such processes will soon come into general use in the United States. The TVA research covers six variations of the nitraphosphate process, such as are represented chemically by the equations in the diagram.

PROCESSES FOR PRODUCTION OF FERTILISERS FROM ROCK PHOSPHATE, NITRIC ACID, AND AMMONIA


SLURRY-TYPE PROCESSES
Process I: Rock phosphate, nitric and phosphoric acids, and ammonia
Rock phosphate $Ca_{10}F_2(PO_4)_6$
10-16 HNO_3 10-4 H_3PO_4
17 NH_3
Drying
x KCl (optional)
9 $CaHPO_4$ 1-7 $NH_4H_2PO_4$ 10-16 NH_4NO_3 CaF_2 x KCl (optional)
Process II: Rock phosphate, nitric and sulphuric acids, and ammonia
Rock phosphate $Ca_{10}F_2(PO_4)_6$
12 HNO_3 4 H_2SO_4
13 NH_3
x KCl (optional)
Drying
5 $CaHPO_4$ 4 $CaSO_4$ 12 NH_4NO_3 $NH_4H_2PO_4$ CaF_2 x KCl (optional)
Process III: Rock phosphate, nitric acid, and ammonia
Rock phosphate $Ca_{10}F_2(PO_4)_6$
20 HNO_3
14 NH_3
3 K_2SO_4*
Drying
6 $CaHPO_4$ 14 NH_4NO_3 6 KNO_3 3 $CaSO_4$ CaF_2
* $(NH_4)_2SO_4$ may be used instead of K_2SO_4.
Process IV: Rock phosphate, nitric acid, and ammonia
Rock phosphate $Ca_{10}F_2(PO_4)_6$
20 HNO_3
14 NH_3
6 NH_3 3 CO_2
Drying*
6 $CaHPO_4$ 20 NH_4NO_3 3 $CaCO_3$ CaF_2
* By including filtration steps, dicalcium phosphate and ammonium nitrate can be produced as separate products.
SUPERPHOSPHATE-TYPE PROCESSES
Process IA: Rock phosphate, nitric and phosphoric acids, and ammonia
Rock phosphate $Ca_{10}F_2(PO_4)_6$
10 HNO_3 4 H_3PO_4
10 NH_3
10-25-0*
Process IIA: Rock phosphate, nitric and sulphuric acids, and ammonia
Rock phosphate $Ca_{10}F_2(PO_4)_6$
6 HNO_3 4 H_2SO_4
6 NH_3
7-18-0*
* Compounds present in products have not been quantitatively determined.

Summary

In summary it may be said that the rapidly changing situation with respect to fertiliser industry in the United States is due to:

(*a*) A greatly increased demand for fertilisers and the prediction of the U.S. Department of Agriculture, perhaps too sanguine, that the demand will continue to expand very rapidly.

(*b*) Companies not previously fertiliser producers have entered the field, and several of the established fertiliser companies are expanding and diversifying their outputs.

(*c*) Ammonia, once relatively costly and produced by only a few companies, is now produced at lower costs in the synthetic ammonia plants built during and since World War II. Ammonium nitrate is now widely used as fertiliser.

(*d*) The production of concentrated superphosphate is increasing as farmer appreciation of the economies of the more concentrated fertilisers progresses. Advancing freight rates and the interest in uranium recovery from rock phosphate are also factors in this change.

Industry in the Tennessee Valley helps to maintain U.S. fertiliser supplies

(*e*) Scarcity and advancing costs of sulphur and sulphuric acid are stimulating interest in processes requiring less of this acid.

(*f*) Production of elemental phosphorus is expanding very rapidly, and while this is not as yet a factor in the fertiliser situation it may soon become such.

(*g*) Processes in which nitric acid replaces a part or all of the sulphuric or phosphoric acid used in making superphosphate are attracting wide interest.

(*h*) Potash production in the United States is increasing rapidly.

Photos: U.S.I.S.

New Tobacco Strains Popular in Southern Rhodesia

Tests of flue-cured tobacco varieties at the three stations of the Tobacco Research Board of Southern Rhodesia so far show Delcrest and Bonanza well in the lead, with Yellow Mammoth and White Mammoth contending for third place and the old Rhodesian favourites, White Stem Orinoco and Jamaica Wrapper, just behind them. The results of these tests are contained in the first of a series of interim reports to be issued by the Board for the information of growers. The relative usefulness of each variety is calculated statistically from field experiment results and the final crop index takes account of both the yield per acre and the relative value of the leaf as graded.

Delcrest topped the list in both grade and yield last season, producing a crop index of 525, compared with 500 for Bonanza.

These results were obtained by summarising the data from all three stations where ten varieties were under test. By comparison, White Stem Orinoco achieved a crop index of 447 and Jamaica Wrapper 438.

If results in future seasons confirm these preliminary results, it is to be expected that newer varieties will oust the old favourites from the preference of Rhodesian farmers.

Israeli Agricultural Expansion

The irrigated area in Israel has risen from 210,000 to 500,000 dunams* (or 10% of the total area under cultivation) in the past four years, but the rapid development of the country's water resources and the full exploitation of the available manpower potential are vital if Israel is to achieve self-sufficiency in the production of foodstuffs.

Experts are of the opinion that by the construction of reservoirs and the transfer of water to arid areas, the irrigated area could be increased to 2.5 million dunams. The maximum achievement during 1952 was placed at a further 150,000 dunams.

The Ministry of Agriculture is seeking to encourage young people to study agriculture in order to ensure a minimum reserve of trained agriculturists and experts. The present number of 5,000 students in the agricultural schools is insufficient to ensure a high standard of farming.

The Government is keenly interested in the development of industrial crops, such as flax, cotton, sugar beet and crops for the production of cellulose (for the paper industry) and would extend its active support to any initiative in this sphere.

In the course of four years of statehood 350 new settlements and extensions of existing settlements have been established. Their total population numbers 70,000.

*One dunam = quarter of an acre.

Mechanising Gold Coast Agriculture

An instructor from the Ferguson School of Mechanised Farming in Warwickshire, Mr. William Baxter, left England by air for the Gold Coast on January 27 to assist the Department of Agriculture in training farm machinery instructors. The first course was due to begin at the Kumasi College of Technology on February 1. Its purpose is to train a nucleus of men so that they can teach and lead Agriculture Department staff and others who will be employed to extend the use of farm machinery in the Gold Coast.

These plans are closely linked with other developments in the Gold Coast, namely, the Volta River Hydro-electric Scheme, the creation of new townships to serve new industries and public services and, probably most significant of all, the complete reorientation of traditional farming practices and land management.

The Volta River project is the largest Colonial development scheme in history—a 20-year plan costing at least £144 million. The Volta Dam will create the biggest artificial lake in the world, 2,000 miles in extent. It will serve a hydro-electric power station to provide electric power to a large aluminium smelting plant.

The project includes large-scale programmes of irrigation for increased food production throughout the Volta River basin and the Accra plains.

Developments in Drift Spraying

R. J. COURSHEE, B.Sc.
National Institute of Agriculture Engineering

Drift spraying is attracting more and more attention as a means of applying pesticides to crops. The subject was dealt with in our issue for October last, which readers will recollect featured several aspects of spraying. The following article again considers the question, this time from a somewhat different angle.

EXCEPT in countries where land is intensively cultivated in relatively small unit areas a major change is occurring in the way chemical pest control methods are employed. Early spraying methods using highly phytotoxic chemicals, led to a form of sprayer which used large quantities of water projected at high pressures to dilute the chemical, to form small drops from the liquid and to project them on to the target to give reasonably uniform coverage.

The machines to spray in this way on row crops are necessarily heavy, expensive and require considerable power to operate them. The nozzles are carried on a spar up to 60 ft. long so that in each passage of the sprayer a strip, or swathe as it is commonly called, up to 60 ft. wide is covered.

Requisites for spraying machines

When it is necessary to spray very large areas cheaply and quickly three characteristics of this type of spraying begin to become troublesome (two of them are equally criticisms of low-volume spraying when using a boom). These are, in order of importance for most situations, (*a*) speed of coverage and therefore cost, (*b*) the difficulty of obtaining adequate water supplies, and (*c*) the difficulty or undesirability of making repeated traverses over the crop with heavy-wheeled vehicles.

The speed of covering the area to be sprayed is of primary importance. A boom sprayer can treat between a half and ten acres (the largest sprayer of this type) an hour. There are many instances where a speed of 10 to 100 acres an hour would be desirable in order to cope with, for example, a flush of tea blister blight. The cost of such sprayers would, however, normally prohibit the ownership and use of several machines operating simultaneously.

Alternatively, when it is not necessary to spray a large area *very* quickly it is often desirable that one machine should cover a *very* large area quickly. That is to say, one pest may make it necessary to spray an area of 100 acres in a matter of hours, whereas another may cause a target to be set of, say, 1,000 acres in a few weeks. Both tasks are far behind the capabilities of one boom sprayer, and in those countries where pest control is becoming important the cost of several sprayers cannot be met by the value of the crop.

Water supplies

The supply difficulties for the water required for high-volume spraying may prohibit its use in many areas, because water cannot usually be obtained in sufficient quantity, and even if it could be the time consumed in wasteful carting would prevent its use. This criticism would not apply to the spraying of undiluted materials, but in practice the difficulties of 100% concentrate spraying with a boom sprayer (in particular the difficulties of keeping the dosage rate down) have so far prevented the use of materials in this way.

Swathe widths

The third criticism is that spraying only a very narrow band in each traverse necessitates repeated crossings of the crop. In many crops this is not possible. Cotton, for example, will not tolerate frequent passage of heavy machines and it is sometimes advisable to remove a row of bushes at widely spaced intervals in order to permit the passage of a drift sprayer capable of spraying the whole of the crop between the lanes, which may be 100 yds. apart.

By spraying a far wider swathe in each traverse and using concentrated materials at far lower dosage rates (down to 2 or 3 lb. per acre) drift spraying can achieve the aim of spraying very quickly indeed at an economic capital and operating cost.

Aim of drift sprayers

Drift spraying is not new in principle since it has been used in aircraft spraying for many years. Its aim is to form a cloud of droplets of spray, in a line running across the wind, of such size that they fall slowly and during the time taken to fall they drift downwind to a distance dependant upon the speed of the wind.

Land-based drift sprayers

It is only recently, however, that the same principle has been applied to sprayers working from the ground, and it is these with which we are mainly concerned. A drift sprayer, the 'Airflow' (Fig. 1), designed by Kearns of Long Ashton for locust control work, is typical of this type of machine; Fig. 2 shows a deposit density

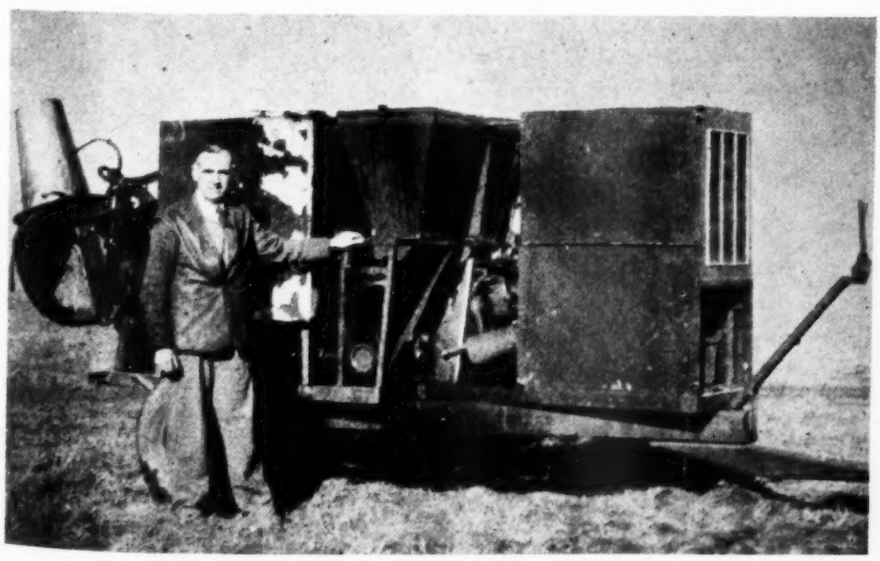


Fig. 1—Airflow Sprayer mounted on a Ferguson trailer

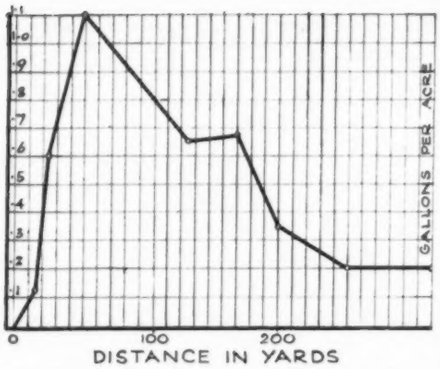


Fig. 2—Deposit density plotted against distance from sprayer

curve giving the measured dosage rate at different distances from the sprayer, actually obtained with the Airflow.

The Airflow was designed for a special job, and is quite considerably larger than most drift sprayers. It covers a swathe 300 yd. wide in each traverse, whereas the more widely used machines are lighter and smaller and cover a 100-yd. wide swathe approximately.

It may be seen from Fig. 2 that the dosage rate is far from even over the swathe and so to some extent the swathes must overlap and some areas be sprayed twice in order to make the dose more nearly uniform. Complete uniformity is not possible, but a result near enough to the ideal to do a thorough job is readily obtained.

We have not actually measured the deposits when the swathes are overlapped, but the sort of result which would be obtained is shown in Fig. 3.

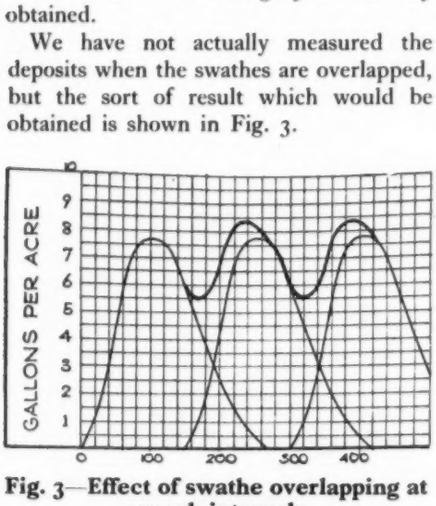


Fig. 3—Effect of swathe overlapping at 150-yd. intervals

This type of drift sprayer blows the small droplets of spray vertically to a suitable height, where they may be carried horizontally by the wind while they slowly drift towards the ground. A rather lower priced type of drift sprayer made in an experimental form by Drake & Fletcher of Maidstone consists of an array of nozzles carried at the top of a mast which may be as high as 30 ft. above the bed of the truck. Both have the same result in forming a cloud of droplets high above the ground.

Aircraft spraying

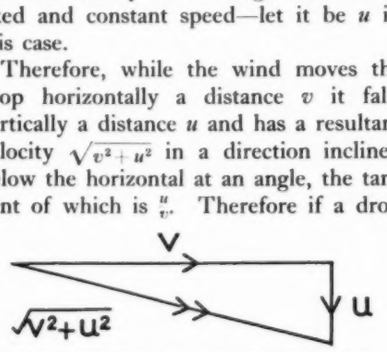
Spraying from fixed-wing aircraft (but not usually from helicopters) follows an identical pattern. A cloud of droplets is formed while the aircraft flies across wind.

Mention of the rate at which the Airflow sprays, illustrates why this development work is likely to be so important. On a good surface the Airflow can make a speed of six miles per hour and can spray a band 200 yd. wide covering an acre every eight or nine seconds.

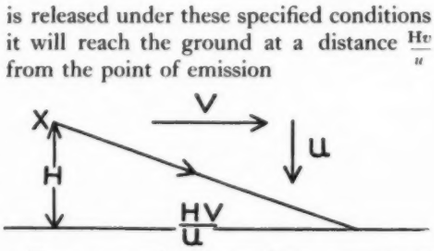
Aircraft spraying is a suitable starting point from which to discuss drift spraying both on account of its simplicity and also because it is the forerunner of drift spraying with ground machines.

The question to be answered is: If a drop of fluid of diameter D and density d is released at a height H above the ground in a wind speed v, where will it hit the ground? Neglecting for the moment complications like diffusion and the variation of wind speed with height, the answer may be obtained simply by drawing a triangle of velocities. A drop of a given size and density falls through the air at a fixed and constant speed—let it be u in this case.

Therefore, while the wind moves the drop horizontally a distance v it falls vertically a distance u and has a resultant velocity $\sqrt{v^2+u^2}$ in a direction inclined below the horizontal at an angle, the tangent of which is $\frac{u}{v}$. Therefore if a drop



is released under these specified conditions it will reach the ground at a distance $\frac{Hv}{u}$ from the point of emission



From a nozzle of any form a range of drop sizes is obtained. The relationship between the relative frequency of occurrence of drops of different sizes is known as the nozzle drop spectrum. A typical drop spectrum from a low-volume nozzle is shown in Fig. 4. When several different drop sizes are released simultaneously the larger drops which have a greater terminal velocity (Fig. 5) fall to the ground along a more steeply inclined path and land near the aircraft track, whereas the smaller

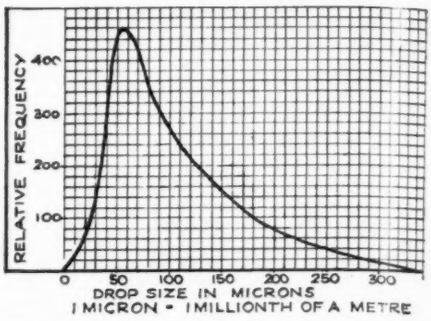


Fig. 4—Nozzle drop spectrum; one micron is one millionth of a metre

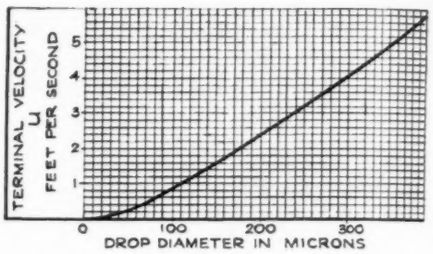


Fig. 5—Drop falling speed; density one gm./cc.

drops travel more nearly horizontally and land further away.

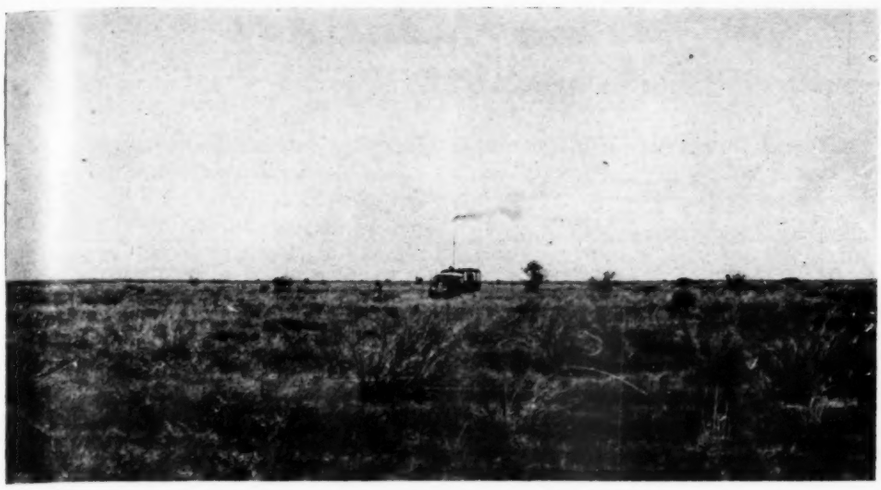
Armed with a graph of the form in Fig. 4, and knowing the terminal velocities of each drop size, it is possible to calculate where all the drops will land and produce theoretically a deposit density curve similar in form to the experimental one of Fig. 2. This has been done and quite good agreement of theory with experiment has been obtained.

Spraying with ground machines

When using ground machines, however, a rather different state of affairs exists. Firstly, it is not possible, economically, to project the spray droplets much higher than 50 ft. or so, depending upon the wind speed. Therefore, if we wish them to drift 100 yd. very small drops having a small terminal velocity must be employed and these travel very nearly horizontally. In a ten-mile-an-hour wind a 100 micron drop (4/1,000ths of an inch diameter) will fall at an angle of about five degrees below the horizontal.

When a drop falls as slowly as this it begins to behave like a smoke or aerosol, and instead of travelling along a straight-line course to the target it is moved from side to side and back and forth with every little gust and eddy of air.

Therefore a cloud of 100 micron droplets would be scattered like a trail of smoke from a chimney—some of the drops landing quite near the sprayer and others landing very far away.



A drift sprayer in action, the cloud of spray drops drifting downwind

One set of experimental results for droplets in the size range 195 to 225 microns is shown in Fig. 6. From this graph it is possible to work out that some of the drops fall at an effective angle of five degrees below the horizontal and some as much as 20 degrees, although they should, in a streamlined airflow, fall at an angle of about 12 degrees.

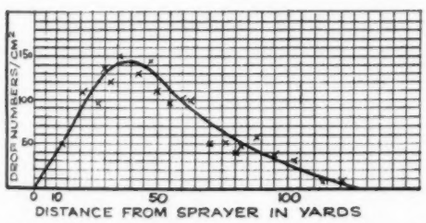


Fig. 6—A distribution of drops of nearly equal size (195-225 microns)

Drops of this size are in fact moved by diffusion—the normal process in the atmosphere by which smoke is spread from its source—so that they are scattered over a wide area.

When spraying from an aeroplane and using the aircraft's own speed to break up the liquid pouring from a pipe, relatively large drops are formed (about 500 microns). These are less susceptible to this process of diffusion and fall more steeply so that the pattern of drops on the ground shows quite clearly large drops near the sprayer trailing off to smaller and smaller drops further away. With ground sprayers and using far smaller drops which all fall at very shallow angles, between one and ten degrees below the horizontal (mean values), the spreading caused by diffusion is much more powerful than the spreading caused by the difference in drop sizes. So that while larger drops may be more predominant near the sprayer they are also mingled with smaller drops. Similarly, at the extremely range the deposit is composed mostly of small drops but includes some larger ones.

It is necessary to emphasise this mingling caused by diffusion because although in aircraft spraying we can control to a large extent the path of the larger drops, no such control is possible with the smaller ones. It will be remembered that small drops are essential for a wide swathe to be covered in each passage; it is therefore the atmospheric stability which, in controlling eddy diffusion, determines the behaviour of the sprays, while the weather must be watched very carefully since a change in turbulence can alter the results considerably.

Diffusion

The power of diffusion forces is very much greater than one would imagine at first sight, and they are very important in controlling the efficiency of operations. Particular dangers may arise from the drift of toxic or unpleasant materials beyond the spraying region through diffusion forces being greater than they had been estimated to be. The danger of drift of poisonous material over livestock or of hormone weedkillers over susceptible crops, virtually prohibits the use of drift spraying in countries of small fields, although, even in England, there are regions as well as pests and poisons that are well suited to this method of treatment. Colorado beetle control is one example, where the potato fields are sufficiently large and drift spraying can be safely employed. Unexpected results can, however, occur at times, as when one, unnamed, development team sprayed the local policeman's washing hanging on the line to dry, a quarter of a mile away from the sprayer.

Losses due to unsuitable weather

Considerable losses of valuable chemicals can occur through working under unsuitable weather conditions, *e.g.* in strong sunshine when a lot of spray floats upwards and never settles. Another cause of loss arises from vertical surfaces blocking large areas downwind which are thus shielded from the spray.

There are therefore difficulties, which it is hoped will in the end be overcome, in the way of widespread acceptance of this method of spraying. Often, however, they are of negligible importance compared with the advantages which the method offers. Mosquito control on a very large scale, for example, only became possible after the work by Hochberg and La Mer on drift spraying. The need to control

(*Concluded on page* 119)

Micron sprayer at work in the Saudi Arabian desert

The Cuttack Rice Research Institute

FIRST COOPERATIVE EFFORT FOR IMPROVING YIELDS

FOR cooperative action as regards production, conservation, distribution and consumption of rice, FAO has appointed an International Rice Commission to initiate, wherever possible, cooperative projects for increased production of this staple food. One such scheme, known as the International Rice Hybridisation Project, is now functioning at the Cuttack Rice Research Institute.

The project is for the benefit of the participating countries such as Pakistan, Burma, Ceylon, Indonesia, Indo-China, Japan, Malaya, Philippines and Thailand. Its unique nature lies in the fact that it is the first cooperative attempt at breeding, worked out on an international basis, in the history of rice improvement.

The project is run by funds provided by FAO as well as by contributions from the participating countries.

With a population which has doubled in the last 75 years and which might double again in the shorter period of 50 to 60 years, India is faced with the growing urgency of raising and improving the yield of rice. The average yield of clean rice in India is 750 lb. per acre, although yields of 2,500 lb. have been obtained in Japan. Both climate and variety are responsible for the low Indian yields.

Project work

Experimental work aimed at evolving improved paddy seeds has been carried on at the Cuttack Rice Research Institute (India) since 1950 under the International Rice Hybridisation Project sponsored by FAO. The project is run by funds provided by the FAO as well as by contributions from the participating countries. A training centre for officers from the participating countries has recently been opened at the Institute. Sixteen officers from abroad and eight officers from different parts of India will receive training for three months at the centre.

Rice is found in over 8,000 varieties all over the world, but only a few varieties are commercially important. These come under two main heads: the *Indica* and *Japonica* stocks. The *Indica* variety is sown in India, Indo-China, Indonesia, Burma, Thailand, Ceylon, Philippines, Palestine and other tropical countries. The *Japonica* type is found in the subtropics, the countries of Europe, in Italy and Spain, Japan, the northern areas of China, Korea and Australia.

The two types differ in some fundamental respects. The *Japonica* type with round grains thrives well in cool climates. It responds to fertilisers and produces high yields, as in Italy and Japan. The *Indica* type has long grains, requires warm climate and produces a fair crop on soil with low fertility. It responds to fertilisers up to a point, but after that fertilisers only give it vegetative growth but no further grain formation.

In subtropical regions the hardy *Indica* varieties give a generally low yield. Since the rice plant is so very sensitive to climatic environment, *Japonica* varieties cannot be grown in India to produce the same results as elsewhere. It is here that the need for hybridisation comes in.

Hybridisation experiments

At the Central Rice Research Centre at Cuttack, with its 190-acre farm, hybridisation experiments centre on breeding varieties giving high yields and which respond to manuring. This is sought to be achieved by crossing Indian and South-East Asian varieties of rice with Japanese varieties known for high yields in Japan.

The hybridisation scheme works in two stages. The crosses are to be made for all the participating countries and the first hybrid generation is raised at the Central Rice Research Institute. The seeds of the hybrids are then supplied to the participating countries for growing the second and subsequent hybrid generation. This second stage of the work is done in the participating countries themselves who, after growing the second and subsequent hybrid generation plants, select suitable varieties adaptable to local conditions.

At the Cuttack Institute over 30 *Indica* parents submitted by nine countries have been crossed with eight *Japonica* types. This consists of about 150 cross combinations out of a total of about 270 envisaged in the scheme. In all, as many as 115,000 flowers have been individually crossed and about 15,000 hybrid seeds obtained. During last year 3,000 hybrid seeds have been raised from these crossed seeds. The Institute has collected seeds from these hybrid plants and sent them to the respective participating countries for starting the second stage of the project, *i.e.* growing the hybrid parents and selecting suitable ones from them.

Indian hybridisation scheme

The hybrid seeds destined for India are still under study. In the international scheme four *Indica* varieties of rice from India had been included for crossing with *Japonica* types, but India has about 4,000 varieties of rice. To meet the full requirements of India, therefore, a hybridisation scheme financed by the Indian Council of Agricultural Research is also being carried out at the Institute, in which 33 *Indica* varieties from the various States of India are being crossed with *Japonica* varieties. This scheme will be completed within three years.

Today in India, following continued research, about 300 improved varieties of rice are available. Improved varieties give 15% to 20% more yield than the conventional types grown so far.

Synthetic rice

Besides these efforts aimed at increasing production yields, there is also the endeavour to expedite production of synthetic rice at a low price and with a nutritive value at least equal to that of rice. The Deputy Food Minister, inaugurating a meeting of the Synthetic Rice Committee on October 27, advocated the accelerated production of synthetic rice on the grounds that not only was population increasing at a phenomenal rate, but that the accelerated tempo of industrialisation was bringing about a migration of agricultural labour to urban centres. If the expansion of industrialisation goes on at the present speed, world food prices would have to rise roughly to double the present prices when compared with the industrial earnings, if sufficient labour was to be attracted back to agriculture.

RICE PRODUCTION IN 1951-52 AS PERCENTAGES OF PRE-WAR OUTPUT

Country	*Percentage Production*	*Country*	*Percentage Production*
Burma ..	75	Formosa	106
Thailand ..	151	India ..	100
Indo-China	87	Pakistan	114
Indonesia	101	Ceylon ..	108
Philippines	123	Malaya	114

Kenaf Tests in Australia

The Australian Wool Board reports that the first shipment of kenaf as a possible substitute for jute has been tested in Australian rope and bag factories with promising results. The country's annual expenditure on jute is £A30,000,000, and the shortage of jute and the high price of bags has emphasised the need for the sheep and wool industry to be independent of overseas supplies.

The Pure Seed Company

H. HUNTER, M.A., D.Sc.
Formerly Director of the Cambridge University Plant Breeding Institute

This is the final article in the present series of 'Industry's Contribution to Agricultural Research.' It deals with the work of the Pure Seed Co., Ltd., and, incidentally, shows how the work of officially sponsored research stations must for its full fruition be closely linked with that of commercial firms in order to ensure that the results and products of research become readily available to the agricultural public. In this series we have described the existing set-up in this respect for 14 commercial firms, covering the whole range of crop production, and demonstrated by examples how pure research in University and Experiment Station laboratories and experiment fields must be associated with effort by private enterprise to ensure its effective and economic development and utilisation by those whom it is designed to benefit. The examples we have quoted are sufficient to demonstrate amply how effective and rewarding such a combination can be. Instances could be multiplied almost indefinitely, and although we certainly would not exclude the possibility of publicising parallel work by other firms should it appear that they possess the requisite degree of importance and interest, we feel that enough has been said in this series of articles to prove conclusively that a system which involves collaboration between official and commercial interests can accomplish most efficiently and economically the successful application of scientific research to the improvement of agriculture. We ourselves remain convinced that the examples we have described provide ample demonstration of the value and effectiveness of this mode of collaboration, and we doubt whether equally successful results could be attained by other methods, including the operations of an entirely state-controlled economy so dear to the hearts of totalitarian ideologies.

Accordingly, we hope that in the future this mode of collaboration may in the democratic world become regarded as the standard, and, indeed, the only sensible and practical way of tackling this all-important task.

IN a recent address to the Fellows of the National Institute of Agricultural Botany, Cambridge, Professor Å. Åkerman, Director of the Swedish Seed Association, Svalöf, presented some interesting figures relating to the improvements that have been effected in farm crops by breeding. He mentioned, for example, that the yields of winter wheat in Sweden today are 30% greater than those of the old 'land' varieties in use 50 years ago, and that a betterment of 20% marked the advance in spring wheat. Similarly, oats and barley each showed advances in yield of 20%, but in addition to these significant economic results each cereal exhibited other desirable attributes such as better standing straw, and improved qualitative values which are not readily assessed.

These figures are a tribute to the application of an aspect of agricultural development that with Svalöf as a model is now being actively pursued in all civilised countries.

In essence research such as that carried out at plant breeding institutes furnishes plant material of high potential value to the agriculturist, but the quantity of new material that can be made available by the breeder is necessarily small in comparison with the large quantities utilised following the wider appreciation of the new product. Between the stage at which a new product leaves the breeder's hands and that at which it is developed sufficiently for extended use there is a series of propagations which demands the maintenance of the original trueness to name of the stock and its botanical purity.

Trueness to name, the first of these requisites, requires little elaboration since it is obvious that unless the farmer is guaranteed on this point the value of breeding effort, and succeeding that, the results of comparative tests of any given variety, which alone justify its launching into general circulation, are largely vitiated.

Impurities in seed stock

But a bulk of seed, even if it exhibits a high degree of trueness to name, may be impaired in both a quantitative and qualitative sense by the presence of seeds of other varieties of the same cereal or of seeds of other cereals. Moreover, once an impurity occurs there is no guarantee that its extent will be maintained at one figure, for the conditions under which a crop is grown may favour the impurity at the expense of the bulk of the crop. Tall straw varieties, for example, naturally shade those of less height, and early developing varieties compete strongly with those of less rapid establishment. On the other hand, an impurity may suffer in like directions, and its contribution to the final crop will be correspondingly reduced. Thus, the nature and manner of origin of impurities in seed stocks are matters of importance particularly when viewed in their aggregate effect over the whole cereal acreage of the country.

Mechanically produced impurities

Broadly, mixtures originate mechanically or through changes in the nature of the seed itself. One frequent cause of mechanical mixtures is the practice of sowing one cereal crop after another, but there are many others, some of which are peculiar to the farm itself, and others very general·

dirty seed drills and sacks, and above all dirty threshing machines all make their contribution. Finally, seed-cleaning machinery is often a gross offender.

Genetic mutations

The second source of mixture is to a large extent unpredictable and uncontrollable, and calls for the exercise of expert knowledge, and very close supervision during all stages of the growth of a crop. Mixtures under this heading arise, first, from mutations or sudden genetical changes of considerable proportions, and, secondly, from ordinary genetical segregations which are detectable when the number of unit plants under observation is relatively large. Changes appearing under the latter heading are in themselves usually small, and although heritable, are in essence matters of degree. They may operate in a plus or minus direction for any specific character; that is, they may enhance or reduce the value of a character as it appeared in the original stock of seed. Earl barley is a good illustration of this nature of change for it appeared in Spratt-Archer more than 25 years after that variety was first issued in 1914, and became noticeable because it was seven to ten days earlier in ripening than its parent variety; in all other features except its greater earliness it was similar to the stock of Spratt-Archer in which it was found.

Plant breeding organisations

The ultimate object of all plant breeding organisations is first to raise and then to issue seed of crops of proved superior merit. Their primary objective is effected by skilled scientific staffs, but the building up of bulks of seed of improved varieties of sufficient magnitude for general circulation to the farming industry calls for a training and experience not usually associated with purely scientific operations. This side of crop development has been tackled in different ways in different countries, but always with the one object of securing seed of improved plants with a high degree of trueness to name and botanical purity. In Sweden, for example, the products of the Svalöf Seed Association are increased in bulk from small nucleus stocks by the Swedish General Seed Company, who are closely affiliated with the Seed Association, and are the only seed company permitted to issue ' original seed ' of the Svalöf products.

The N.I.A.B.

In this country the products of the Cambridge University Plant Breeding Station and of other plant breeding organisations are issued to Fellows of the National Institute of Agricultural Botany as stocks become available. The quantity of any cereal allocated to each Fellow is relatively small, and in practice this involves the handling of a limited acreage for one or two seasons by a large number of growers at a great many different centres. Thus, for a period the new seed is subject to the risks of mechanical mixtures at a stage when the potentiality of a small mixture is numerically the highest. If, instead of four or five or even ten acres a farmer could grow 20 acres the numerical proportion of a small mixture, although at all times undesirable, would be reduced. Added to this, in agricultural practice it is much easier to handle larger areas at all stages of production than relatively small ones.

The Pure Seed Co.

It was with the object of undertaking what may be termed the intermediate stage of propagation of approved varieties of cereal and other seeds that the Pure Seed Co. Ltd. was founded. Commencing with initial stocks of approved varieties obtained from the National Institute of Agricultural Botany or similar institutes at home and abroad, the Pure Seed Co. increase these stocks until they reach a stage which obviates the crucial work of early propagation on a large number of individual farms.

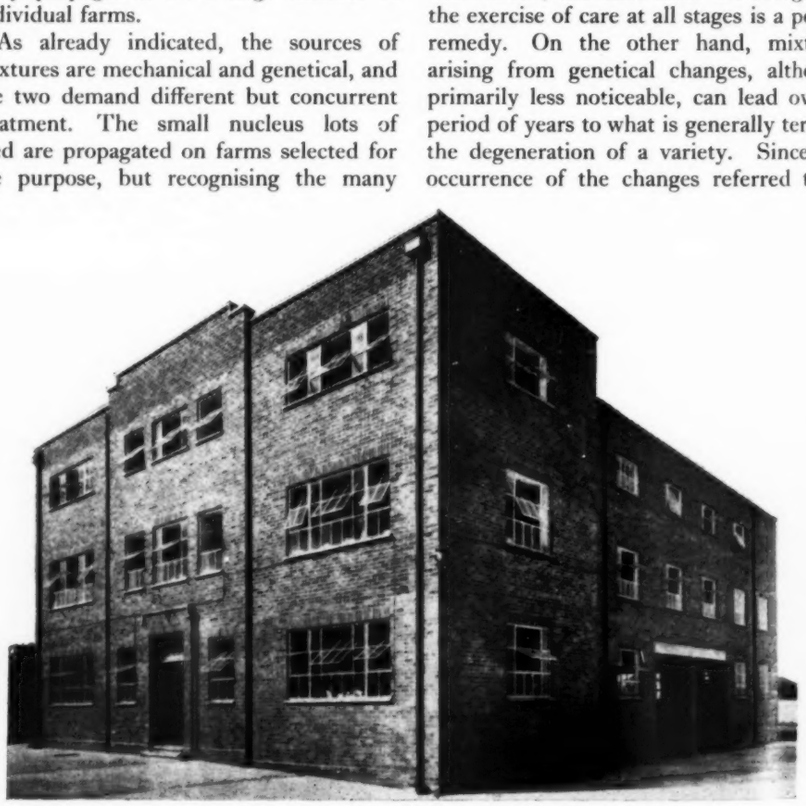
As already indicated, the sources of mixtures are mechanical and genetical, and the two demand different but concurrent treatment. The small nucleus lots of seed are propagated on farms selected for the purpose, but recognising the many ways by which troubles arise the Pure Seed Co. established a scientific staff whose duties include the selection of land for propagation, the close supervision of all cultural operations, including threshing and the delivery of the seed to the seed-cleaning station.

Seed cleaning plant

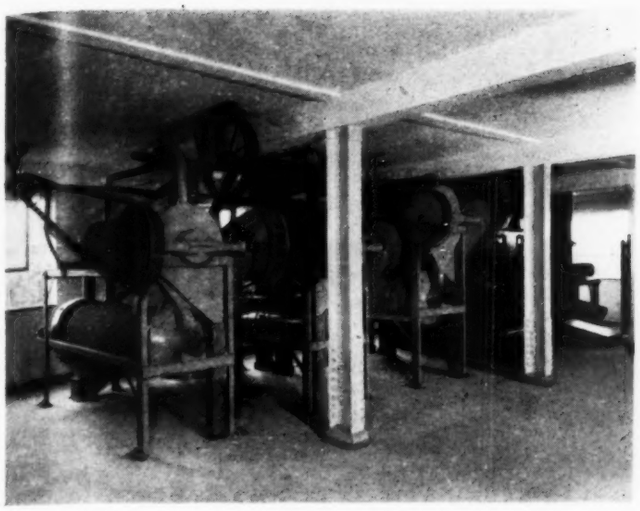
At no stage in the handling of stocks of seed is the danger of contamination greater than in seed-cleaning plants. These are necessarily somewhat complicated in structure, and are rarely designed with an appreciation of the large number of varieties of different classes of seed with which they are intended to deal. Recognising this fact, the Pure Seed Co. erected a seed-cleaning plant at Linton, Cambs., specially designed to ensure efficient and easy supervision of every operation of cleaning, and to permit of easy but complete cleaning of the plant itself between one stock or variety of seed and another.

Thus, in so far as mixtures arise from mechanical agencies, the whole gamut of possibilities is provided for from the sowing of the nucleus stock up to the time the produce is ready for extended use by the agricultural community.

The detection of the sources of mechanical contamination is largely a matter of observation, and once these are recognised the exercise of care at all stages is a potent remedy. On the other hand, mixtures arising from genetical changes, although primarily less noticeable, can lead over a period of years to what is generally termed the degeneration of a variety. Since the occurrence of the changes referred to is



Headquarters of the Pure Seed Company, where the seed-cleaning plant is installed



(*Left*) **A battery of ultra indented cylinders and a seed-cleaning machine; (*right*) oat clipper installation**

unpredictable, the maintenance of a stock in its original condition calls for special measures to ensure their identification at the earliest possible stage of propagation.

Maintenance of stocks

Stocks of named varieties are frequently raised from a single plant of the variety, the produce being multiplied yearly as an individual unit until sufficient quantities are produced to sow substantial areas. But it is now widely recognised that the produce of single plants may change gradually; in other words, single plants, especially of hybrid origin, are rarely 'fixed' for all characters. They may be 'fixed' for many of the more obvious morphological characters, but not for the many physiological characters of which earliness in ripening may be taken as an example. The changes involved are frequently small, but may nevertheless operate cumulatively to the detriment of the original value of a stock. For this reason where values in particular directions are the peculiar characteristics of a variety it is now considered desirable to select from a crop of the variety, the origin of which is known, as large a number of single plants as possible yearly or at short intervals, and to grow each line separately under strictly comparable conditions. The adoption of this yardstick of comparison enables changes in individual units to be detected at a very early stage. If they assume sufficiently large proportions the line displaying them may be discarded; alternatively, the observed changes may be of such a nature as to warrant further observation, and plants exhibiting the change or changes may be propagated further to provide pabulum on which final decisions may be made.

Lines that appear homogenous may be massed together to form a new foundation bulk or a single good line may be chosen to form the basic of future propagation.

Investigations of this nature require not only a scientifically trained staff but suitable land on which critical growth tests can be carried out. For this side of their activities the Pure Seed Co. have provided the Technical Branch of the Company with eight acres of land adjoining their granary building; a further provision of cereal and chemical laboratories is made in the same building.

Critical growth tests are carried out by the Technical Branch on eight acres of land adjoining the granary building

Cereal seed

The production of cereal seed of the highest standard, although a fundamental activity, is only one side of the Pure Seed organisation. Commercial interests dealing with basic products like cereals are fully cognisant of the differential value of the varieties in general circulation in relation to their particular processing requirements. This necessitates a closer alignment of production and final utilisation of agricultural products to an extent not attempted previously. For example: the value of rye for biscuit manufacture is largely determined by the amount of water-soluble protein which is present in some varieties to a greater amount than in others. But it may be increased in all varieties by the application of appropriate fertilisers at definite stages in the development of the crop. The solution of the problem of the most suitable time of application of fertilisers and of the quantities that can be used without detriment to the standing power of the crop has a direct bearing on commercial operations.

Similarly, the optimum date of sowing rye, because of its bearing on the final yield and possibly the quality of the crop, is a subject for applied research.

Lucerne

A further subject with a very direct bearing on agricultural development, particularly in the east and south-east of England, is the proper cultivation of lucerne (alfalfa) both as a pure crop and in conjunction with different grasses. The value of lucerne, either as hay or when artificially dried and converted into meal, depends primarily on the quantity of protein it contains, and this in turn on the stage of growth at which the crop is cut. But apart from questions of gross yields of hay or grass there are significant differences in the manner and extent to which varieties tiller and hence produce more or less fibre, and in the rate at which they recover after each ' cut ' is secured. To manufacturers of lucerne meal these are all factors influencing the quality, that is, the protein content, of the processed product, and must be determined not only for different soils but for different systems of farming.

Grasses

Not less important commercially is the question of the most suitable grass to include with lucerne when such mixed cropping is practised. Cocksfoot is favoured nowadays for this purpose, but the exact type of cocksfoot to use is a matter to be determined. It is probable that in eastern districts an indigenous type may be most remunerative, and with this possibility in mind a large number of single plants of cocksfoot have been collected and developed as unit cultures. This may rightly be regarded as long-range research since it involves many determinations of agricultural importance, but, finally, where the crop is intended for meal manufacture qualitative values demand collateral attention.

Dormancy in barley

A further illustration of a condition well known to certain commercial interests, and one in which research may assist, is the low dormancy of a variety of barley indigenous to Scotland, where it is known as ' Scotch Common.' This barley, which is one of the old ' land ' types, possesses a low dormancy, that is, there is a very short period of time between full ripeness and the stage at which the grain is able to germinate readily. As a consequence of this attribute maltsters using Scotch Common can commence their season's malting almost immediately the grain is delivered into the maltings. This position is in marked contrast to that met with in many other varieties of barley which require a period of rest between full ripeness and the stage at which they will germinate satisfactorily. As the season of malting is restricted between a date in autumn and a date in spring it follows that any delay in commencing malting in the autumn militates against the potentiality of a malthouse, and hence its yearly output of malt.

Scotch Common as it exists in commerce is a mixed ' population ' of forms, but all of the narrow-ear type of barley, and it is thus possible that in the ' population ' there are forms of lower dormancy than the average bulk. By adopting the single plant method of selection some forms have already been isolated which exhibit a much higher degree of low dormancy than the average, and are to this extent more valuable for cultivation where the market demands grain of this particular type. On the other hand, other units display high dormancy and may accordingly be utilised in directions where this particular feature is desired.

Apart from all general considerations the isolation of units with special attributes advances their value to the farmer who is placed in a position to produce grain possessing the highest degree of certain desired qualities—a position of definite advantage to the maltster also.

' Agrosan ' powder dressers

Photos: Thomas Robinson and Son Ltd. (except p. 115, bottom).

Great Floods: Salt Damage to Thousands of Acres

The floods which devastated coastal areas of the North Sea during the weekend of January 31-February 2 caused flooding of some 250,000 acres of land in Britain. Sea walls protecting low-lying land from the Thames to the Humber were breached and salt water swept across field and farm inundating, in some cases, land that had been claimed from the sea hundreds of years ago.

Affected farmers are doing their best to accelerate the receding flood waters, for, while salt water lies over the land, the soil is absorbing sodium and the sodium particles exchange with the calcium particles of the soil, particularly in the case of the heavy clays, to give an unworkable soil, sticky and structureless in winter and rock-hard in dry weather.

Speaking on the radio recently, Prof. Sir James Scott Watson, Chief Scientific Advisor to the Ministry of Agriculture, said, '. . . our common crops will not grow so long as there is a lot of salt in the soil. Some can tolerate more than others. About a ton and a half of salt per acre is pretty safe. Beet will stand two tons, barley perhaps two and a half, and the common grasses from three to five.'

An acre of sea water lying a foot deep contains about 35 tons of salt, hence the importance of getting the sea water off the land as soon as possible.

Dutch Flood Disaster

The Dutch Government has banned the export of potatoes as the recent disastrous floods are believed to have ruined thousands of tons in underground clamps.

In Zeeland, renowned for its potato and fruit crops, it may be two to four years before the soil is restored to its normal fertility.

No estimate is yet available of possible damage to other crops owing to the breakdown of communications with the affected areas. Total damage to crop farms, roads and livestock is said to run into ' many hundreds of millions of guilders.' Nearly 450,000 acres of fertile soil in South Holland, Zeeland and North-Brabant have been inundated.

RESEARCH DEVELOPMENTS

Sytam, A New Systemic Insecticide

M. PIANKA, M.Sc., A.R.I.C.

SYTAM, the new systemic insecticide,[1] manufactured by the Murphy Chemical Co. Ltd., is based on schradan (bisdimethylaminophosphonous anhydride). It possesses certain properties not associated with other systemic insecticides.

Manufacture

Technical schradan, which forms the basis of Sytam, is produced by a novel process in which bisdimethylaminochlorophosphine oxide is reacted in an organic solvent with solid alkali. The water of reaction is entrained in the solvent and continually eliminated from the sphere of reaction. The technical schradan is obtained by separating the solution from the alkali chloride and distilling off the solvent. A typical preparation was found to consist of 3.6% solvent, 9.4% trisdimethylaminophosphine oxide, 80% schradan and 7% residue of dimethylamides of polyphosphoric acids, a substantial proportion of which consists of tetraphosphoric hexadimethylamide.

This process differs from others in current use in that it yields technical schradan containing a very small proportion of triphosphoric pentadimethylamide (TPD). The other processes yield technical schradan containing from 25% to 39% of TPD.[2]

Because of the negligible proportion it contains of TPD, which hydrolyses much more rapidly than schradan,[2] Sytam has a very high stability. No deterioration in biological activity of the formulated material or change in composition of the technical schradan was observed on storing for two months at 50° C.

Activation principle[1]

Sytam does not exhibit contact insecticidal properties; it is, however, a quick-acting systemic insecticide. Thus, when applied to hops as a spray at 12 fluid oz. per 100 gal., total kills of hop blight and red spider were observed within 24 hours. This property, not associated with schradan (which usually takes four to six days before becoming fully effective) or any other systemic material based on schradan, is due to the inclusion in Sytam of certain non-insecticidal, non-oxidising activators. The term activator is preferred to that of synergist, since it is better to retain the classical term synergism (cooperation) for cases where each individual constituent of the synergistic mixture is itself biologically active. These activators also enhance insecticidal activity, in addition to making it more rapid. Thus the actual proportion of schradan in the activated insecticidal mixture can be reduced without impairing its insecticidal efficiency.

The duration of the insecticidal activity of the activated mixtures depends on the activators used. Comparative tests using pure schradan as the standard show that, whereas some activators reduce the life of schradan, others do not curtail its persistence at all.

Evidence obtained suggests that the activation effect decreases with increase in the molecular weight of the systemic insecticide. Thus the activation effect on bisdimethylaminofluorophosphine oxide (BFPO for which the trivial name dimefox has now been adopted) (molecular weight 154) appears to be greater than that on schradan (molecular weight 286), whereas the activation on TPD (molecular weight 393) is of a negative order, causing a substantial de-activation. Thus systemic insecticides containing mixtures of schradan and TPD are not activated.

Synergism in the case of contact insecticides is well known. The discovery of activators for systemic insecticides which enhance their activity and render them much quicker-acting is especially useful.

A true systemic insecticide is by its very nature slower acting than a contact insecticide. Attempts have been made to quicken the action of insecticidal sprays containing systemic materials by including contact insecticides such as parathion or tetraethyl pyrophosphate (TEPP). Other systemic insecticides have been developed (for example, Systox[3]) which, in addition to their systemic properties, have contact insecticidal action. This latter is, however, harmful to predators. Since Sytam has no contact insecticidal activity, it is thus the first quick-acting *true* systemic insecticide which is lethal to sucking pests only, and harmless to predators.

Details of this work will be published at a future date. My thanks are due to Miss K. E. Phillips, B.Sc.(Hortic.), for the biological comparative systemic tests carried out by a technique developed by her, details of which will be published later; to Mr. B. D. Owen, B.Sc., A.R.I.C., for the phosphorus and dimethylamine determinations; and to the Directors of the Murphy Chemical Co. Ltd. for permission to publish this note.

REFERENCES

1. British and Foreign patents on the manufacture and activation of systemics are pending.
2. Hartley *et al.*: *J. Sci. Food Agric.*, 1951, **2**, 7, pp. 305, 306.
3. Goodman: WORLD CROPS, 1952, **4**, 350; Hartley: *Ibid.*, p. 397; Dowdy and Sleesman, *J. Econ. Ent.*, 1952, **45**, 640.

Milking Machine Development

An open meeting of the Institution of British Agricultural Engineers was held on January 21 when a paper, entitled 'The Design and Development of Milking Machines,' was presented by H. S. Hall, B.Sc., M.I.B.A.E.

The speaker opened by pointing out that most of the basic principles of the modern milking machine were established by 1903 but, in spite of this, probably less than 20,000 herds in Great Britain were machine milked in 1939. War conditions rapidly changed the situation and by January 1953 the number of machines nearly equalled the number of herds with ten or more cows. Manufacture increased to correspond with this demand. It was shown that in 1950 and 1951 only half the number of plants manufactured were installed and production in 1952 therefore necessarily declined.

Design problems

Modern research in machine milking, affecting the principles of machine design and use, was reviewed and the principal findings of British, New Zealand, American and other workers compared. General considerations affecting vacuum pump capacity and the difficulty of prescribing a specific capacity for a given duty were then discussed. An optimum operating vacuum still cannot be stated; probably there is no virtue in using less than 13 in. mercury, and while values above 15 in. may be suspected of being associated with mastitis there is no proof that higher values cannot be used if suitable precautions, yet to be decided, are adopted.

Teat cups

There is no evidence yet that any particular form of pulse characteristic is to be preferred and the speaker considered that the complications resulting from pulsating pairs of teats alternately were not justified.

Teat-cup design was considered to be the aspect in which knowledge is most lacking and to which future work should be directed.

NEW BOOKS

Tea Pests and Diseases and Their Control

By Ernest Hainsworth. Pp. xi + 124, illustrated. W. Heffer & Sons Ltd., Cambridge, 1952. 18s.

Among tropical crops tea is perhaps noteworthy for the works which have appeared dealing with its pests and diseases. These include Sir George Watt and Dr. H. H. Mann's monumental work, *Pests and Blights of the Tea Bush*, first published as long ago as 1903, T. Petch's *Diseases of the Tea Bush*, as well as du Pasquier's *Principales Maladies du Thé et du Caféier en Extreme Orient*.

The present work constitutes an important addition to those and provides an up-to-date account of the various pests and diseases which attack the tea bush under Indian conditions. The author was formerly plant pathologist to the Indian Tea Association and the information contained in his book is the result of experience gained when working in that capacity at the Tocklai experiment station.

As the author says in his introduction, 'the book is intended to be a practical guide to the tea planter and assist him in identifying the pests and diseases which affect his crop,' and not a monograph on tea pests nor a compendium of experimental records. The need for books of this type is considerable and very real, but for the achievement of their aim the information they impart must be carefully chosen and skilfully presented. This the author has succeeded in achieving, for the book is concise, informative, reliable and very readable. The important chapter on root diseases (Chapter V) strikes one as a particularly good example of skilful presentation for an audience of this type.

There is a foreword by Dr. H. H. Mann, the first Director of Tocklai and co-author with the late Sir George Watt of the first book on pests and diseases of tea referred to above. Dr. Mann comments on the way in which knowledge of the maladies affecting the tea bush has expanded since the earlier work was written; new maladies have appeared and old ones have changed their intensity and incidence; new methods of treatment have been discovered and new techniques of application invented.

Dr. Mann considers that at the present juncture the book fills a definite want and should find a valued place in the library of every tea planter in Northern India. With this one can agree, for within its 124 well-printed pages the book admirably fulfils its intention; it should be assured of a favourable reception. It is illustrated by 31 well-chosen and excellently reproduced photographs.

The Flowering Plants of the Anglo-Egyptian Sudan

Vol. II. By F. W. Andrews, D.Sc., Ph.D., lately Chief Economic Botanist, Sudan Government. Pp. 485, illustrated. T. Buncle, Arbroath, 21s.

This is the second volume of the flora of the Sudan compiled by Dr. Andrews and it includes the natural families from the *Sterculiaceae* to the *Dipsacaceae*. The compilation is most painstakingly done and will, no doubt, be of the greatest value to specialists occupied with the subject as well as to the general reader and others concerned with botanical science and related subjects in the Sudan.

The text is illustrated by numerous excellent line drawings of the forms described, a number of which have been drawn from living material in the Sudan by Mrs. Andrews. The work has been accomplished in collaboration and consultation with the authorities of the British Museum of Natural History and the Royal Botanic Gardens, Kew, of which acknowledgments are made in the preface.

The work is a notable addition to the steadily growing number of floras of tropical and sub-tropical countries.

The Fruit Annual, 1952-53

A Yearbook and Directory of the World Fruit Trade. Edited by H. F. Tyser. Pp. 423. British Continental Trade Press, London, 1953, 20s.

This is the second year of this publication which aims at providing concise and comprehensive information about all of the main aspects of the world trade in fresh and dried fruit.

It contains a survey of the world's fruit trade in 1952 and details concerning a number of aspects of fruit production, including citrus fruit, tropical fruit, dried fruit and edible nuts. In addition, there are chapters on developments in refrigeration, canning technique, consumer packaging, a directory of fruit trade organisations, list of journals of interest to the fruit trade, dictionary of fruit terms, shippers' guide and a directory of the world trade in fruit.

As a reference book and a *vade mecum* for all connected with the trade in fruit in all parts of the world the work is to be highly commended. Indeed, we can hardly conceive of anybody in this category who could afford to be without this excellent publication.

The work is attractively produced, printed on good paper and nicely bound in a green cloth cover. At a pound, as prices for books go today, it represents exceedingly good value.

The Agricultural Tractor

By P. H. Southwell. Pp. vii + 170, illustrated. Temple Press, London, 1953. 15s.

This is believed to be the first British book to be written solely on the design and performance of agricultural tractors, and as such is a noteworthy contribution to the field of farming literature in general and agricultural engineering literature in particular. Mr. P. H. Southwell, the author, is already known to readers of WORLD CROPS by his engineering articles which have appeared in the Journal from time to time. He is also a member of the staff of the National Institute of Agricultural Engineering, and is therefore well qualified to write this book.

The book analyses the design, construction and operation of agricultural tractors in some detail, dividing the subject, broadly, into three aspects, namely, engine, transmission system and ground drive. To get down to more detail, the chapter on 'Fuels and Oils' contains a very clear exposition of the natures and properties of the three fuels, petrol, vaporising oil and diesel fuel, and some thoughtful words on fuel economy, a subject which is frequently overlooked or under-emphasised in textbooks. Similarly, the chapter on the ground drive components (wheels and tracks) contains a thorough discussion of the principles and considerations involved.

Mr. Southwell has also included information on what he describes as 'further design factors,' *i.e.* components and accessories other than the three major items of engine, transmission and ground drive components. They include the drawbar,

To Authors and Readers

The Editor and publishers of WORLD CROPS will be glad to consider manuscripts of books submitted for publication. We already publish a number of books on technical subjects, all of which find a world sale, and most call for regular reprints and new editions.

Books of a non-fictional type in any language by any publisher can be supplied by the Book Department of WORLD CROPS.

the hydraulic system, the power take-off, weight distribution and implement effects.

The final chapter contains some interesting speculations on future trends in the design of agricultural tractors. Such topics as engine interchangeability, fluid coupling transmissions, and interchangeability of wheels and tracks are here discussed and should be of special interest to professional agricultural engineers.

The scope of the book includes tracklayers and wheel tractors, but not horticultural tractors. Although numerically small, these latter are becoming a growing influence in mechanised agriculture and the author might consider including a section on these machines in a future edition.

Mr. Southwell may be congratulated on producing a book which will supply the needs of agricultural and agricultural engineering students, besides the wider public of the professional farmer and engineer.

Farm Power

By the late Ben D. Moses and Kenneth R. Frost. Pp. 484, illustrated. Chapman and Hall, London, and John Wiley & Sons, New York, 1952, 46s.

American textbooks have, deservedly, a reputation for thoroughness and attention to detail in most technical and scientific subjects, and *Farm Power* is no exception to the rule. Within its 465 pages of text this book, planned primarily for college students in agriculture and agricultural engineering, contains a study of the internal combustion engine and the farm tractor, and their principal parts, attachments and related equipment. Every aspect of the subject is gone into with great thoroughness, setting forth many integrated facts culled from laboratory and field experience obtained by farmers, manufacturers, college research workers and Government agencies during the last 50 years. Of the authors, the late Professor Moses was Emeritus Professor of Agricultural Engineering at the University of California, having been in the Division of Agricultural Engineering for 29 years; Kenneth Frost is Assistant Professor of Agricultural Engineering at the University of Arizona and has been teaching farm power for 20 years.

The book is divided into three parts, relating to farm power development and utilisation, internal combustion engines and tractors. The treatment of each subject, as, for instance, methods of ignition or of power transmission, starts with the consideration of fundamentals and the principles involved, an advantage, particularly where students are concerned. Also, at the end of each chapter are set a number of problems on the subject covered.

The book, being written by Americans, naturally contains much American terminology, but this need not cause apprehension to British readers, since the number of times that an Americanism is likely to cause confusion is negligible. The intelligent use of illustrations enhances the value of the work and it should become a popular textbook for the student and the farmer who is anxious to learn the ' why ' and ' how ' of his tractor as well as its performance capabilities.

Plant Environment and the Grower

An interesting booklet on the above subject has recently been written by a Sussex grower, Mr. Sidney A. Searle, with the object of showing the important part that environment plays in horticultural crop production. The author has made extensive measurements both in commercial greenhouses and in outdoor crops of such factors as soil temperature, air temperature, humidity, air movement, sunshine and light, and transpiration. Details of the instruments used are given, including the new soil moisture meter, or tensiometer, which has been introduced to growers by Messrs. A. Gallenkamp and Co. Ltd.

The study of plant environment has opened up avenues of knowledge regarding optimum conditions for commercially grown plants and the advantageous use of this knowledge, as indicated in this booklet, cannot fail to benefit production in the normal market garden.

The optimum ' climate ' for the growth of a specific plant necessitates the study of all possible environmental factors.

Developments in Drift Spraying

(*Concluded from page* 111)

locusts was largely responsible for much of the development work described above.

Conclusion

When suitable operating instructions are available it seems likely that the method will provide an economic and efficient method of routine pest control, provided that a suitable range of machines for using it under different conditions can be developed. This probably means that a source of equal sized drops as in the Clean Crops Micron Sprayer will be required in order to ensure a sharp limit in the range of drop sizes. Large particles may have to be used on occasion despite the superior penetrating power of small particles in working their way through dense foliage. These are, however, problems to be solved, while in any event there are advantages which attach to drift spraying and ensure its employment in many important spraying tasks in the future.

Photo: P. 111 *(bottom), Clean Crops Ltd.*

Malayan Investigations into the Mechanised Cultivation of Padi

From time to time progress reports have been published by the Malayan Department of Agriculture on their mechanisation experiments on rice cultivation under the various soil conditions in that country. Recently there has appeared a special bulletin of the Department which covers the period 1948 to early 1951, and in addition provides a general review of the experiments to date, including a report by a Mission sent from the United Kingdom in 1949 to advise on the work. The publication gives an overall picture of the experiments from their inception, from which certain conclusions of importance are drawn.

Three soil conditions characterise the rice lands in Malaya: (*a*) coastal soils suitable for dry-land rice, (*b*) coastal clay soils suited to irrigation, and (*c*) peat soils. Mechanisation for dry rice on coastal clays presents no great difficulties, while the deep ploughing made possible by mechanisation enables the fertiliser to be placed fairly deeply in the soil and may increase yields by at least 50%. Much of the irrigated land already developed for rice in Malaya is on coastal clay soils. On these most of the cultural operations have been successfully mechanised. The area of land of this type in Malaya at present undeveloped is uncertain, but may not be extensive, so that, unless it is found that mechanisation is justified by increased yields, the scope for mechanised cultivation may depend on its employment to overcome labour shortages.

The prospects for the mechanisation of rice cultivation on peat soils are not promising. It has been found impractical to remove the large number of stumps and hidden timbers, and without their removal mechanical cultivation is impossible. Furthermore, removal of such timber results in shrinkage of the peat, thereby complicating drainage and irrigation. The shrinkage also brings to light further timbers buried in the soil. As a result of these experiments, and in view of the recommendations of the Mission, it was decided to discontinue mechanisation experiments on peat soils.

This is a momentous decision. If the high cost of removing the submerged timber from such land is indeed prohibitive, the world area of potential rice land may well be less than supposed, and it seems probable that considerable areas of similar land in many tropical countries must remain for long unreclaimed.

D.H.G.

Colonial Agricultural Research 1951-52

THE wealth of the United Kingdom dependencies lies chiefly in the products their soils can grow, and to produce disease-free crops and forests suited to the enormous variety of soils is a continual subject of research. Research, too, is undertaken with the object of increasing and improving livestock in the dependencies, and of increasing the amount of protein available by discovering and maintaining fishery resources and the best methods of using them.

These subjects, amongst others, figure prominently in the published reports of several of the advisory Colonial research bodies during 1951-52, and the following account summarises some of the activities recorded in the reports of the Committee for Colonial Agricultural, Animal Health and Forestry Research; the Colonial Insecticides, Fungicides and Herbicides Committee; The Tsetse Fly and Trypanosomiasis Committee and the Anti-Locust Research Centre.

As with social and economic research, agricultural, forestry, animal health and fisheries research in the dependencies is largely being developed on a regional basis.

East Africa

The East African Agricultural and Forestry Research Organisation (EAAFRO) and the East African Veterinary Research Organisation (EAVRO) both now have their headquarters at Muguga South, in Kenya. EAAFRO, during 1951-52, was engaged in examining the results of fertiliser trials, in soil surveys, researches on soil physics, plant breeding and in research on various aspects of forest pathology, plant physiology, and silvicultural problems. EAVRO went ahead with building up foundation stocks of highly standardised strains of laboratory animals, continued research into East Coast Fever of cattle and animal helminthology (the study of parasitic worms), completed a tuberculosis survey in Tanganyika and continued studies on animal nutrition. In association with the East African Tsetse and Trypanosomiasis Research Organisation in Uganda, research on animal trypanosomiasis was also continued. The Tsetse and Trypanosomiasis Research Organisation was also active in experimenting with tsetse control and reclamation schemes, and made surveys in various parts of East Africa. £200,000 has been granted to it from United Kingdom Colonial Development and Welfare funds for three pilot reclamation schemes.

Much of the work of the Colonial Insecticides Committee has a bearing on tsetse problems and those arising from the control of other agricultural pests. The Colonial Insecticides Research Unit in East Africa, for instance, tried out aerial spraying of bush infested with tsetse, and laboratory and field studies on aircraft application of chemicals to vegetation and other agricultural pests continued.

West Africa

After a survey of research in West Africa, it was concluded that a large-scale West African organisation for agricultural and forestry research was not feasible, but that there should be better co-ordination of agricultural research. Proposals to achieve this have been under consideration, and in the meantime two regional research schemes covering rice cultivation and rust diseases of maize have been started.

The Regional centre for rice research is at Rokupr in Sierra Leone, which in 1948 received United Kingdom Colonial Development and Welfare funds for the purpose. During 1951-52 a further grant of £70,600 was made to expand the station and help to maintain it for four years. Amongst the problems on which it is working are the difficulties of drainage, maintenance of fertility and the removal of salt and other toxic substances from the wetland areas available in Sierra Leone for rice cultivation.

Maize rust research is to be based on Moor Plantation, Ibadan, Nigeria, and a United Kingdom Colonial Development and Welfare grant of £34,500 has been made for the purpose. The need for this unit has arisen from the fact that in 1950 a rust disease previously recorded only in the warmer parts of America became epidemic on maize throughout West Africa and is probably now responsible for damage to about 50% of the crops.

Two of West Africa's most important crops, cacao and oil palm, have their own regional research stations. The West African Cacao Research Station works on investigations into the diseases and pests of cacao, the agronomy of the crop, breeding of improved types and problems of cacao fermentation, while the West African Institute for Oil Palm Research has been engaged in field experiments, plant breeding, production of improved seed, studies of nursery root disease and of variation in the oil content of fruit.

West Indies

Proposals for a regional research centre based on the Imperial College of Tropical Agriculture, Trinidad, have been submitted to the West Indian Governments for consideration. The College is already administering three major Colonial Development and Welfare research schemes on cacao, bananas and soils, which are of regional importance, and during 1951-52 work on these continued. Cacao research includes breeding strains resistant to witches' broom disease and examining conditions affecting growth. Research into banana breeding has yielded new and promising varieties of seedling, one of which is resistant both to panama disease and leaf spot. Soils research has resulted in the construction of maps for most territories showing intensity or distribution of effective rainfall, vegetation and land form, and in a published series of articles on the soils and agriculture of the territories.

Far East

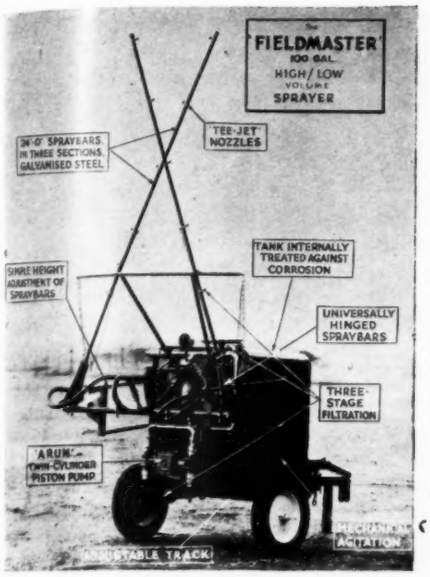
The territories in the Far East do not, like those in Africa and the Caribbean, have economies largely based on crops, and, while there is a Rubber Research Institute in the Federation of Malaya to deal with this valuable commodity, there has been no need to tackle agricultural problems on a regional basis. Individual projects are, however, undertaken with the aid of United Kingdom Colonial Development and Welfare funds. Agricultural research is, for instance, under way at the Serdang Agricultural Experimental Station near Kuala Lumpur.

Locust research and control

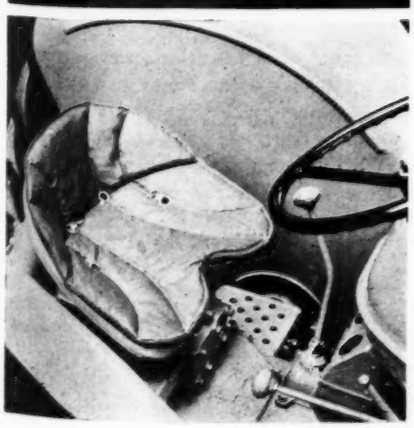
Regional organisations engaged in locust control and research are the International Red Locust Control Service at Abercorn, Northern Rhodesia, the Provisional International Council for the Control of the African Migratory Locust, the Desert Locust Survey, the Moroccan Locust Research Team in Cyprus, and the Desert Locust Control Organisation based in Nairobi, Kenya. Amongst the achievements of their staffs during 1951-52 were bringing under control incipient red locust outbreaks in Central Africa, keeping under control the outbreak area of the African Migratory Locust on the Middle Niger, successful experiments with aircraft for aerial spraying of locusts in Kenya, exploration of little known desert locust areas in Arabia, and research into and field operations against the Moroccan locust in Cyprus. The Desert Locust Control Organisation in Nairobi conducted extensive operations in several countries.

An encouraging feature of the present control campaign is the growing international cooperation.

FARM MACHINERY



Fieldmaster Model U.T.P., 100 gal. high- and low-volume trailer sprayer



(*Above*) **Waterproof cover for New Fordson Major, and** (*below*) **imitation leather seat cushion**

Spraying Machines for 1953

At their Bourn headquarters Messrs. Pest Control Ltd. recently demonstrated a selection of their spraying machines prior to their being sent out on the road on a demonstration tour up and down the country.

The smallest machine to be shown was the Weedmaster Model 111 low-volume tractor-mounted sprayer. This can be obtained for rigid mounting on the tractor (£70) or to fit the three-point linkage (£78). It is reported that over 5,500 of these machines have been sold during the last three years in the U.K. alone.

The Fieldmaster Model U.T.P., which was introduced at the Smithfield Show last December and described in our January issue, was also demonstrated. This is a high- and low-volume p.t.o.-driven trailer machine with 100 gal. tank internally treated against corrosion and fitted with mechanical agitator. The agitator shaft drives the 'Arun' twin cylinder plunger pump which is mounted at the rear of the tank, having an output of 15 gal. per min. at 200 lb./sq. in. Spraybar height can be adjusted by a ratchet fitting on the rear frame without the use of tools; spraybars of 24 ft. width are fitted. Price of the Fieldmaster is £205.

The 200-gal. Universal Major (Model U.M.T.P.) has been reduced in price by 10% to £360, and the 'Arun' pump, designed, incidentally, by Pest Control Ltd. engineers, now replaces the old piston pump. For rapid filling a built-in injector

Weedmaster Model III, designed to fit the tractor three-point linkage system

is incorporated in this model. A 25-ft. spraybar in three sections is fitted with 33 Majestic nozzles for high-volume spraying or with 17 Teejet nozzles for low-volume work.

The above-mentioned are the four machines which this firm will tour in different parts of the country.

Automotive hop sprayer

This is an unusual machine Pest Control have developed for use in hop gardens when spraying toxic chemicals in particular. The narrowness of rows makes necessary a design with no projecting features which might catch in the hop bines. The sprayer consists of an International T.6 tracklayer with spray tanks built along the sides, vertical spraybars at the back and the controls in an air-conditioned and enclosed cab projecting from the front of the tractor. Spraying is high volume by high pressure.

Accessories for the New Fordson Major

Two accessories are now available for the New Fordson Major. A tractor cover has been designed and approved by Ford Motor Co. Ltd., made from heavy, preshrunk, waterproofed canvas and tailored to fit the tractor from radiator to driver's seat. The second item is a seat cushion, reversible and secured by two tapes. It is made of imitation leather in red or blue and filled with rubberised horse-hair.

One-Man Sugar Beet Harvester

A tractor-mounted sugar beet harvester was demonstrated recently on difficult soil conditions and is reported as having given good results under the circumstances. The machine is manufactured by Messrs. T. Baker and Sons (Foundry and Engineers) Ltd. It is power take-off driven and costs £155 ex works.

Rotavator News

Rotary Hoes Ltd. have announced the formation of a new company in the United States. This company, Howard Rotavator Company Inc. of Illinois, is located at 1600 East Davis Street, Arlington Heights, Illinois, and has been formed as a subsidiary of Howard Rotavators Incorporated. The new company will be responsible for the marketing of Howard rotavators, Allen scythes and Ransomes tractors in the Middle West.

From February 1 the following price changes came into operation for the 'Gem' III:

	Old Price	New Price
'Gem' III 18 in. and 20 in. Steel	£170	£180
'Gem' III 18 in. and 20 in. Rubber	£175	£185

Prices of other rotavator 'Gem' models remain unchanged.

Jet-Operated Fog Generator

Weighing approximately 30 lb., the Swingfog generator is the latest fog-producing machine to be introduced to British and overseas markets. Extensive trials and tests have been carried out in Germany, both indoors and outside, with encouraging results—particularly in warehouses, food stores, etc.

Various tests have been carried out in forest nurseries, using oil-based insecticide as the fogging material. Swingfog has proved successful in connection with frost protection. The average rise in temperature that can be expected after using this method in orchards or nurseries at night is stated from reports received to be about 3° C., although this has been exceeded under favourable conditions. Continuous fogging from midnight until 6 a.m. uses about 20 litres of diesel oil and 2½ litres of petrol.

100% effective kill has been reported from the use of the Swingfog on potatoes against colorado beetle in June. 1.8 hectares of potatoes were fogged in 36 min., using 13 kg. of insecticide.

Malaya Mechanises

While the terrorist war in Malaya continues, those concerned with the well-being of the Federation's agriculture are not allowing plans for the future to be neglected. One of the most important recent developments is in mechanisation, particularly on rubber estates, and the first training course for tractor drivers to be run by the Department of Agriculture was held recently at the Department's Experimental Station at Cheras, Selangor. The chief work of this station is in livestock research; imported cattle and poultry are acclimatised there and progress is carefully checked with the object of improving local strains by cross breeding.

Six Ferguson tractors and a range of implements were used on the course, having been supplied by Borneo Motors Ltd., whose headquarters are in Singapore. Those students who completed the course successfully were awarded certificates.

Scotland Sees New Electric Fencing Equipment

At the recently held Scottish Dairy Show Messrs. Wolseley Sheep Shearing Machine Co. Ltd. showed a new type of tripod for general use, particularly on stony ground and a ⅜ offset post for the same conditions. An offset bamboo post with metal base and a new bell fencer bracket attachment were also shown, these two being evolved to overcome the metal shortage.

Growing Diesel Popularity

Production figures for the New Fordson Major Diesel are now nearly three times higher than those for the V.O. and petrol models combined. In November 1951, when the new tractor was first announced, the Ford Motor Company Ltd. showed that the prevailing price difference between the Diesel and V.O. model had been cut by about 65%, and that, for the first time, a diesel-engined tractor was available at only £100 above the V.O. price. This was done by using many common components in all three types of engine. Research and experience had proved that, to meet rising farm production costs, farmers throughout the world would turn their attention to diesel to provide economical power, providing the price barrier was removed.

During December 1952 production of the New Fordson Major Diesel amounted to 72.75% of the total, V.O. models accounting for 16.1% and petrol 11.15%. This diesel popularity grew rapidly as soon as the model went into production, which was a few weeks later than the other two types.

Heavy drainage plough used in conjunction with flexible pipes. The plough is made by James A. Cuthbertson Ltd. of Biggar, Scotland

Ferguson Co in France

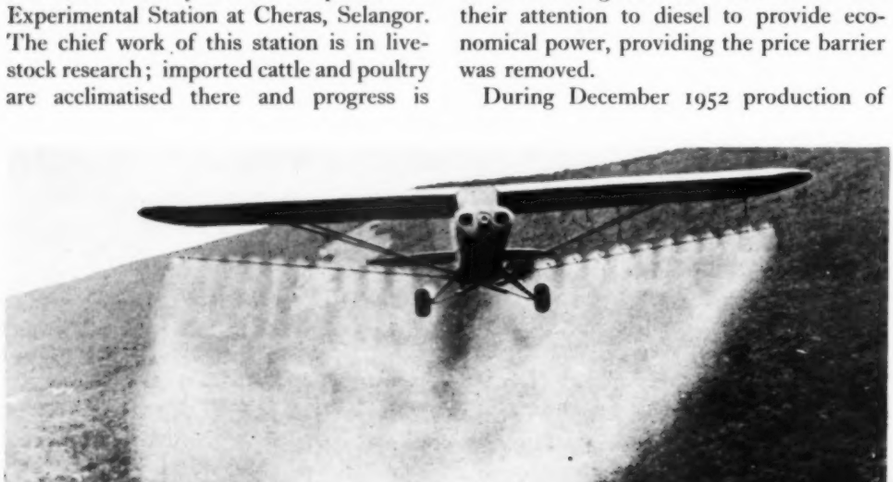
The manufacture in France of Ferguson tractors is shortly to begin. A subsidiary company of Harry Ferguson Holdings Ltd., under the title Harry Ferguson de France S.A., was formed in mid-1952 by the Standard Motor Co. Ltd. in conjunction with the Hotchkiss Company. The new company will duplicate a number of Coventry-designed implements, besides a range of specialised implements designed for use in vineyards and orchards.

New Gun-Type Nozzle

A new gun-type nozzle has been introduced by the Spraying Systems Co. of Bellwood, Illinois. Named the GunJet, it is built for operation at any pressure from 30 to 800 lb./sq. in. The spray is adjustable by turning a handle, to give a varying range from wide angle finely atomised full cone spray, through a full cone spray, to a far reaching straight stream. Orifice tips provide a capacity range of from ¾ to 30 gal./min.

Technical News

'Utilisation of Solar Energy' is the title of an article in the March issue of *Chemical and Process Engineering*. In *Food Manufacture* F. A. Robinson writes on 'Vitamin Progress in 1952' and S. W. Butterworth on 'The Baking Industry.' A review of modern fibres, their production and usage, appears in *Fibres (Natural and Synthetic)*.



The Piper Super Cub performing one of its many agricultural tasks

WORLD CROPS

OUR NEXT ISSUE will include an article by Frank Illingworth, member of the American Polar Society and associate of the Arctic Institute of North America, entitled **Farming Within the Arctic Circle.** P. A. Rowe writes on **Western Canada's Irrigation Schemes** and Donald Mullins on **Cultivation and Processing of the Willow.** Besides these, other articles and features will be included in the April issue.

Aerosol Application in the Glasshouse

A demonstration of fungicide application in the glasshouse by means of the aerosol generator method was recently held at the Meadow Road nurseries of Mr. F. R. Frampton, at Worthing. The machine used for the demonstration was the electrically-operated Microsol '202,' described in WORLD CROPS last year (**4,** 10, pp. 347-348), and the chemical used was a fortified azobenzene fluid normally used for red spider control; this is a special aerosol fluid produced by Pan Britannica Industries Ltd. under the name, A.B.40. The area treated was 120 ft. by 25 ft. 6 in., in all about 18,600 cu. ft., and the time taken to carry out the treatment was just over two minutes, a fine mist of 40 micron size particles being produced.

Pan Britannica Industries claim to have introduced aerosols to the glasshouse industry in the U.K. six years ago with their own, then, revolutionary 'Aerocide' method of treatment. In those days DDT, nicotine and azobenzene (A.B.30) aerosol fluids were all that were available. Now a more complete range of these specially developed fluids is available for use with the Microsol generator, which P.B.I. Ltd. endorse as giving an effective dispersion of these fluids and as being the first readily portable aerosol generator with a large output which works on a mechanical principle.

A local grower, Mr. G. H. L. Ellis, who has pioneered the use of the Microsol method in Great Britain during the last season, has reported complete success when using the machine in his tomato houses, primarily against the fungus disease *cladosporium*, using a mercurial preparation P.M.4. Treatment was carried out weekly from the young plant stage right throughout its life. Mr. Ellis, who has three-quarters of an acre under glass, stated that he could carry out this spraying programme round his houses in under the hour.

PEOPLE IN THE NEWS

Agricultural Advisor to Ceylon

Mr. S. J. Wright, M.A., Agricultural Advisor to Ford Motor Company, is travelling to Ceylon to advise the Government of Ceylon on the possibilities of the mechanisation of tea cultivation. Mr. Wright's services were specially requested by the Tea Research Institute of Ceylon and he has been seconded for this mission. Arrangements have been made for Mr. Wright's visit under the Technical Co-operation Scheme of the Colombo Plan.

Before leaving, Mr. Wright, who visited Ceylon last year, intimated that tea cultivation presented special problems because of the nature of the terrain. He will spend about three months in Ceylon on this new venture.

Mr. S. J. Wright, who is visiting Ceylon

African Visits

Mr. C. M. Carr, Joint Managing Director of Plant Protection Ltd. and a Director of Cooper, McDougall & Robertson, left the U.K. by air on January 13 for Entebbe, Uganda. From there he planned to motor through Kenya and Uganda to Nairobi and then on to Johannesburg and Capetown, returning via Salisbury, Khartoum and Cairo.

Two other members of Plant Protection are also *en route* for Africa. They are Mr. W. Cowan, an agronomist from Fernhurst Research Station and Mr. G. G. Murray of the Export Sales Department. They are on a visit to West Africa and expect to be away for about a month.

Mrs. A. C. Howard christening the first Platypus tractor with champagne at Rotary Hoes' new factory. On her right are Mr. Howard and Captain E. N. Griffiths

N.D.Agr.E. Presentations

At a recent Open Meeting of the Institution of British Agricultural Engineers the President, Mr. F. E. Rowland, M.I.E.E., M.I.B.A.E., Member A.S.A.E., presented Diplomas to six of the ten candidates who were successful in the 1952 Examination for the National Diploma in Agricultural Engineering (N.D.Agr.E.).

Before making the presentations, Mr. Rowland said that the Diploma was now recognised as the national qualification for competence in agricultural engineering and that its importance would increase as time went on.

The 1953 Examination will again be held at the Essex Institute of Agriculture, Writtle, nr. Chelmsford, commencing on Tuesday, July 21.

(*Right*) **Canadian agricultural delegation at London airport en route for Switzerland, Pakistan, India and Ceylon.** (*Top to bottom*) **D. Tremblay from Quebec, Rev. N. K. MacKinnan, professor at St. Francis Xavier University, E. Omeara of the Dept. of Agriculture and H. L. Trueman, head of the Dept. of Agriculture, Ottawa**

Copra, Cocoa and Coffee Exports from the South Pacific

THE collection and analysis of economic and statistical data is now being carried out by the South Pacific Commission, to supplement the work of its specialists on cash crops of the South Pacific. The following brief note from the SPC Quarterly Bulletin gives tabulated statistics on exports from the region of copra, cocoa and coffee.

Copra

In 1938 the total quantity of copra exported from the South Pacific territories was about 225,000 tons. On the basis of such statistics as are available this figure is about double the quantity shipped from the region in the year immediately following World War I.

Exports were sharply reduced during World War II, partly as the result of enemy occupation and war-time destruction of exporting areas, and partly as a consequence of the war-time dislocation of normal trade and communications, and the unavoidable neglect of plantations. Copra exports reached their lowest level in 1943, when they were probably no more than 75,000 tons. After 1946 copra production and exports recovered substantially, but in 1950 the volume of copra shipments—approximately 175,000 tons—was still nearly 25% below the 1938 figure.

Table I sets out estimates of copra exports from territories in the South Pacific region during the period 1920 to 1951. As will be seen, the statistics so far assembled are not as complete as might be desired, but it is hoped that it will be possible to obtain the necessary data from the authorities concerned so that a more exact picture may be eventually presented.

TABLE I. COPRA EXPORTS
('000 *tons*)

Territory	*Aver.* 1920-1924	*Aver.* 1925-1929	*Aver.* 1930-1934	*Aver.* 1935-1939	1943	1947	1950	1951
New Guinea	28.0	51.7	61.4	69.3	—	4.4	47.1	64.3
Papua	5.1	9.6	9.8	10.7	2.4	4.8	10.8	9.5
Nauru	(0.1)	0.1	—	—	—	—	—	—
Western Samoa	11.7	13.5	10.9	12.5	7.3	18.2	13.9	14.6
Cook Islands	1.7	1.8	1.5	1.1	0.5	0.8	1.1	1.3
Tokelau Islands	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)	0.3	0.2	0.3
Niue	(0.5)	0.6	0.2	0.4	0.4	0.7	0.9	0.7
Fiji (*b*)	(19.9)	27.8	20.4	30.6	17.7	27.5	10.2	15.4
Solomon Islands	13.3	20.7	21.9	21.9	—	0.5	10.1	(*a*)
Gilbert and Ellice	(5.1)	(4.7)	(6.3)	6.3	0.6	6.6	5.6	(*a*)
Tonga	(12.5)	14.3	10.6	11.8	6.6	19.0	16.7	(*a*)
New Caledonia	(2.5)	3.0	2.4	2.7	—	0.8	2.7	2.6
French Oceania	(12.5)	(13.9)	(18.5)	(21.6)	19.4	20.5	20.4	25.8
New Hebrides	(5.4)	(9.9)	8.6	11.2	16.1	20.4	21.6	27.7
Neth. New Guinea	(*a*)	(*a*)	(*a*)	(4.5)	—	0.5	2.9	3.5
American Samoa	1.3	1.1	0.8	(0.8)	0.1	1.0	1.9	1.0
Guam	(*a*)	(*a*)	(*a*)	(2.0)	—	—	—	—
Trust Territory of Pacific Islands	(*a*)	(*a*)	(*a*)	(14.0)	—	5.0	8.5	10.5
TOTAL	(125.0)	(180.0)	(195.0)	(225.0)	(75.0)	(135.0)	(175.0)	

Notes.—(*a*) Statistics not available at time of publication.
(*b*) Recent copra exports from Fiji should be read in conjunction with the following statistics of copra milled for coconut oil production in Fiji: 1947, 11,500 tons; 1950, 18,800 tons; and 1951, 19,500 tons.
All figures in brackets are rough estimates only.

TABLE III. COFFEE EXPORTS

Period	*New Hebrides* (*a*)	*New Guinea* (*b*)	*Papua* (*b*)	*New Caledonia* (*c*)	*Total*
Average:	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
1930-34	339	—	23	1,060	1,422
1935-39	513	29	83	1,507	2,132
Year:					
1946	278	30	20	926	1,254
1947	354	27	21	1,224	1,626
1948	39	5	2	920	966
1949	197	16	1	815	1,029
1950	153	15	6	1,663	1,837
1951	121	32	—	1,376	—

(*a*) Calendar years; figures supplied by Customs and Inland Revenue, New Hebrides Condominium.
(*b*) Years ending June 30 in year indicated; from Annual Reports of the Administration of the Territory.
(*c*) Calendar years; from official figures of exports from New Caledonia.

Cocoa

Cocoa has been grown in the South Pacific region for at least 50 years, but commercial production has been established only in three territories—Western Samoa, New Hebrides, and the Territory of New Guinea administered by Australia. Exports of cocoa from the South Pacific region as a whole are less than 0.5% of the world total.

Though statistics of cocoa production are not available, export figures give a reasonable indication of the extent and trend of commercial production. Table II illustrates the trend of cocoa exports from the region since 1920. It will be observed that, although the total quantity involved is small, the trend is upwards. Expansion of exports from Western Samoa and Australian New Guinea since World War II has rather more than offset the sharp decline which has occurred in exports from the New Hebrides.

TABLE II. COCOA EXPORTS

Period	*Western Samoa* (*a*)	*New Hebrides* (*b*)	*New Guinea* (*c*)	*Total*
Average	*tons*	*tons*	*tons*	*tons*
1920-24	707	975	116	1,798
1925-29	690	1,845	92	2,627
1930-34	878	1,824	77	2,779
1935-39	1,038	1,693	154	2,885
Year				
1946	1,885	709	14	2,608
1947	2,378	900	48	3,326
1948	1,630	553	114	2,297
1949	2,894	858	200	3,952
1950	1,880	630	207	2,717
1951	3,212	401	317	3,930

(*a*) Calendar years; from Annual Reports of Trade, Commerce and Shipping of the Territory of Western Samoa.
(*b*) Calendar years; 1920-29 rough estimates only, 1930-51 figures supplied by Customs and Inland Revenue, New Hebrides Condominium.
(*c*) Years ending June 30 in year indicated; from Annual Reports of the Administration of the Territory.

Coffee

As in the case of cocoa, coffee has been grown in the South Pacific for at least 50 years. Production on a commercial scale is confined to four territories—New Caledonia, New Hebrides, New Guinea and Papua—the first being by far the most important.

Table III, giving details of coffee exports from these four territories, illustrates the trend in recent years. Shipments from New Caledonia have, on the average, remained at about the level reached just before World War II. In the other territories, however, exports have fallen significantly below pre-war figures.

Plant Hormones—Fourth Annual Fernhurst Lecture

THE subject this year was plant hormones and the speaker opened by differentiating between animal and plant hormones.

Animal hormones, he said, have now been studied for 50 years and a great deal is known about their chemical and physiological properties.

A plant is also an association of different tissues and organs which require the same kind of co-ordination as is necessary in animals. Plants have no nervous system and co-ordination must therefore be through other mechanisms. There are in plants chemical substances which are formed in one part of the plant, pass to other parts, and produce special growth effects, and they are thus entitled to be known as plant hormones.

Hormones and root growth

An example of hormonal regulation in a plant is provided by the relationship between roots and leaves. It is possible to grow excised roots in an aseptic culture medium. If this contains the right substances in the right amounts, these isolated roots grow as fairly normal roots. The medium first employed was one containing a complete array of mineral salts, with added sucrose, normally transported from the leaves to the roots. In successive transfers of flax roots to fresh media it was found that growth became poorer with each successive transfer. The roots needed something for growth which they were either not getting or which they were making in too small an amount. The necessary substance proved to be the vitamin thiamine, and it was needed in the very low concentration of one part to ten million. When supplied the roots grew well.

The nutritional requirements of tomato roots are somewhat different, and vary from strain to strain. Some strains need not only thiamine, but also pyridoxine, nicotinic acid, or both these substances.

Absence of thiamine from the nutrient solution produces characteristic symptoms. Cell division slows down and finally ceases. Thiamine is therefore a factor influencing cell division. It is also a factor influencing respiration.

Pyridoxine is concerned with the synthesis of amino acids; nicotinic acid has to do with respiratory enzymes.

All three substances thus play an essential part in the biochemical economy of the plant.

The lecturer for the fourth Fernhurst Lecture, an annual event endowed by Plant Protection, Ltd., was Professor S. C. Harland, F.R.S., of the Department of Botany, Manchester University. The chair was taken by last year's lecturer, Sir William Ogg, who is the present Director of Rothamsted Experimental Station. The lecture was, as usual, given at the Royal Society of Arts in London.

Leaf and stem growth hormones

Just as there are root growth hormones, there are also leaf growth hormones. If, for example, immature leaves of the pea plant are excised and placed in a nutrient medium containing the usual mineral salts and sugar, they grow very little. But if the amino acid adenine is added growth is promoted. Adenine thus functions as a leaf growth hormone in the pea plant. When tried with leaves of certain cereals, however, it was without effect. It is therefore likely that different species of plants need quite different substances to play the role of leaf growth hormones.

Stem growth hormones comprise a series of hormones which are synthesised in the apical bud or young expanded leaves and then transported to the elongating parts of the stem. If a section from the growing region of a pea plant which has been kept in the dark is placed in a nutrient solution containing mineral salts and sugar, there is practically no growth. But if a small amount of the substance IAA (Indoleacetic acid) is added, there occurs a very rapid elongation of the excised section. Growth substances such as IAA and related compounds are known as auxins.

It is now possible to grow the excised ovaries of tomato in a culture medium. The tiny ovaries are excised shortly after pollination and placed in a medium supplemented by the juice of either green or red tomatoes. This juice presumably contains substances necessary for growth which are probably transported to the ovary from other sites, but neither the sites nor the chemical nature of the substances are known, although lately it has been discovered that the substance NOA (naphthoxyacetic acid) acts as an adequate substitute for tomato juice.

Minute and only partly developed embryos can be caused to develop by using an artificial culture medium supplemented by additional substances in low concentration. These include some vitamins of the B complex such as thiamine and pantothenic acid. Other unidentified compounds are known to be contained in yeast extract, malt extract, and coconut milk.

Wound hormones

When wounds in plants begin to heal the formation of new tissues appears to be started by particular chemical substances liberated from injured cells. These wound-produced substances may also be counted among the plant hormones. One wound hormone has been isolated from injured bean pods and is known as traumatic acid. It is not effective with tissues other than those of the bean and it seems likely that different species of plants are characterised by wound hormones of chemically diverse types.

Plant hormone range

The hormonal function of IAA was first discovered in 1934 and was the first naturally occurring hormone to be identified.

In 1935 Zimmermann and Wilcoxon announced the discovery of other organic synthetic substances with hormonal properties. The most important of these were NAA (naphthalene acetic acid) and IBA (indolebutyric acid). In 1938 Levine established that another substance behaves as a hormone—NOA. In 1942 Zimmermann and Hitchcock reported the effects of yet another synthetic compound on plant growth: 2,4-dichlorophenoxyacetic acid, or 2,4-D.

The list of synthetic substances with growth-regulating properties which can be used in agriculture and horticulture is now very large, and it would serve no useful purpose to refer to any of them individually.

It is, however, of interest to enumerate some of the things which plant hormones can do, and for which they are used: weed control; to cause flowers to remain on a tree; to cause flowers to drop off; to produce fruits without pollination; to prevent the formation of fruit; to cause more fruits to develop; to cause total partial elimination of fruits; to produce earlier fruits; to produce later fruits; to produce seedless fruits; to produce fruits with more seeds; to induce root formation (on cuttings); to prevent the sprouting of

tubers (potato); to cause defoliation; to enable difficult plant hybrids to be made.

Weed control

2,4-D is especially toxic in certain concentrations to broad-leaved weeds, and by spraying it inhibits the growth of these. Applied to the soil it prevents the germination and development of weed seedlings. Its use is favoured by the fact that grasses and cereals are quite resistant except when young, and as broad-leaved dicotyledons are quite sensitive, this enables cereal crops and lawns to be freed from bad weeds of this type with relative ease.

Prevention of pre-harvest fruit drop

Pre-harvest drop of apples has been a headache for the fruit grower for a long time, and one of the first uses of hormone sprays was to reduce this source of loss. Naphthalene acetic acid is applied as a spray at a concentration of ten parts per million or as a dust at 0.1%. The time of application is just as soon as dropping becomes evident. The substance 2, 4, 5-trichlorophenoxyproprionic acid (2, 4, 5-TP) is effective in controlling fruit drop and is also said to improve colour. Varietal differences affect the efficiency of the particular chemical substance used. NAA does not work very well with some varieties, whereas 2,4-D has been successful. Hormonal control of fruit drop in oranges is now a well established practice in California.

Hormones in horticulture

Hormones will prolong the flowering period of such trees as the flowering cherry (*Prunus* spp.). In periods of warm weather the flowers open rapidly and shed quickly, and spraying with NAA or allied compounds will cause the flowers to stay on the trees much longer. The spray should be applied when most of the flowers are fully open. Not all ornamental trees respond to treatment. NAA is also highly effective at a concentration of 20 p.p.m. in preventing holly leaves from dropping.

Several compounds are used, depending on the species involved, to prevent fruit production in flowering trees. NAA works with some species (*e.g.* horse chestnut), but not with others (some types of purple crab apple).

A compound so far not mentioned, maleic hydrazide, was found to prevent the fruiting of the maidenhair tree (*Ginkgo biloba*).

Hormones can be used to hasten rooting of cuttings and to increase the number of roots formed in a given time, but they will not cause roots to form on material that normally does not root, nor can the use of hormones replace horticultural skill. A hormone spray will induce abundant setting of fruit in holly, tomatoes, fuchsias, and many other plants.

Seedless tomatoes can now be produced to order by using a large range of compounds, including indolebutyric acid. Hormone treatment can be used for inhibiting the growth of sprouts in stored potatoes. The hormone used is naphthaleneacetic acid in the form of its methyl ester. The same hormone can also be used for roses and young fruit trees.

Pineapple industry of Hawaii

The pineapple industry of Hawaii is probably the most efficient agricultural large-scale enterprise in the world. It is therefore not surprising that the fullest advantage is taken of the immense possibilities of plant hormones for the control of growth.

Hormones are used to bring varieties into flower at convenient times, some varieties being slower to flower than others; they may take as long as five years. The current practice is to make one application of NAA at a concentration of about one ounce per acre, using large power sprayers. Uniformity of fruiting means increased yields, and exact timing of picking in different fields is now possible.

An interesting sidelight is that NAA induces a very long and weak stem. Another hormone is used to counteract this. Spraying with betanaphthoxyacetic acid delays the ripening of the fruit, increases its size, and at the same time strengthens the stem.

Plant hybrids

Hybridisation between varieties within a species is usually easy. Hybridisation between different species in a genus is more difficult and depends very much on the genus and the species. Many new hybrids, formerly considered to be impossible, have now been made with the aid of plant hormones. Rick in California has even succeeded in crossing the tomato with a wild species of Solanum, native to Southern Peru, using parachlorphenoxyacetic acid in a concentration of 0.01% in lanoline.

The future

It will be apparent that spectacular progress may be expected in the future. In breaking the present barriers to crossing representatives of different genera, for instance, it is apparent that we are in the beginning of a new era of untold promise. A large number of hitherto intractable species combinations have been made though few workers are employed in this field. The control of some important plant diseases and insect pests can best be done by incorporating resistance genes from allied species and genera.

With regard to weed control it is likely that the newer methods of chemical and hormonal control will result in far reaching changes in agricultural practice. If pre-emergence soil treatment could control weeds effectively the planting distance could be reduced, and the yield probably increased by a more intensive cultivation of the soil.

From the standpoint of the plant physiologist it would seem that the characters of plants are not so fixed as was thought. If the flowering time of grasses could be delayed it might be possible to maintain a permanent leafy sward, and radically change the composition of the crop for feeding purposes.

Other modifications may be anticipated. Delayed flowering and quicker maturity may permit plants to be grown outside their normal climatic zones, and the production of parthenocarpic fruits—seedless fruits—will certainly increase. Already almost the whole of the fig industry of California has gone over to seedless fruits. There is some evidence that hormone-produced fruits may be different in chemical composition from those naturally set; it is reported that seedless tomatoes are sweeter.

All the facts which have been mentioned concern the phenomenon of growth—of the factors which control the velocity and regulation of cell division. A study of growth is an exploration of the most fundamental of the properties of living matter of the whole organic world. It is in this study that the points of view of workers in many varied disciplines will coalesce. Any new facts about growth in any organism may profoundly affect knowledge about man himself. The biochemistry of the behaviour of the excised roots of groundsel may seem unconnected with fundamental problems of human disease, but the biochemistry of life comprises an integrated and interlocking series of interrelated facts, and any fact about one organism may tie up in quite an unforeseen way with another fact about another organism.

Discussion

Opening the discussion which followed the lecture, **Sir William Ogg** reminded the audience of the war-time activities of British workers in the field of hormone weedkillers, publication of which was delayed until the end of the war in 1945.

Dr. H. G. Thornton, of Rothamsted, followed this up by mentioning work which he and others had carried out as far back as 1942 on the deformation of root hairs of red clover by bacteria. They found that acetic acid, at a rate of one part per million of soil, gave this deformation but at the same time killed the clover seed. With 2,4-D the chlorine content was found to kill the bacteria.

Dr. W. G. Templeman, of Jealotts Hill Research Station, described work carried out 17 years ago on the nature of organic matter. There were, he said, hundreds—if not thousands—of plant growth regulators being produced and many more new compounds will no doubt appear. The need for widening fundamental work is therefore becoming increasingly important.

Dr. E. Holmes, of Plant Protection Ltd., said that in Great Britain most experimental work was done with MCPA rather than 2,4-D, the properties of the former having been discovered by Dr. Templeman in 1940. In his (Dr. Holmes') opinion MCPA is a safer material than 2,4-D.

Dr. C. R. Metcalfe, referring to work at the Royal Botanic Gardens, Kew, before the war, said that it had been found that cuttings which did not respond to synthetic substances differed anatomically from those that did, particularly in regard to stem tissue thickness, cork layer and the presence or absence of secretory cells.

A New Plant Hormone

Scientists in America have reported the discovery of a new chemical compound for regulating the growth of plants, known as CDAA. Its chemical name is a-cyano-B-(2,4-dichlorophenyl) acrylic acid (Ethyl-214).

'CDAA has been studied in greenhouse experiments on tomato and marigold plants,' according to R. E. Hay and D. P. Uhl, of Battelle Institute, Columbus, Ohio, and W. B. Ligett and Calvin N. Wolf of the Ethyl Corporation Research Laboratories, Detroit, Michigan. 'When applied at low concentrations, this compound produced the effects of inhibiting the growth of the main stem of tomato plants and the flowering of marigold. These results were achieved without visible injury to the plants and without a slowing down of growth.'

Potential uses for CDAA and other derivatives are not confined to tomato plants and marigold, it was pointed out. These plants were selected because they are easy to grow in the greenhouse, thus permitting continuous, year-round research.

CONFERENCE LECTURE

The American Market Garden

'VEGETABLE Growing in America' was the title of an illustrated talk given by Mr. A. D. Harrison, Provincial Vegetable Specialist for the South-East Province, at a horticultural conference on vegetable production organised by the National Agricultural Advisory Service and held at Bedford on January 29.

Mr. Harrison had visited the United States last year as a member of a productivity team studying American methods of fruit and vegetable production. His visit had been confined to the eastern seaboard of the country, from southern Florida to New England.

Vegetables in Florida

Almost the area of the U.K., Florida, the highest point of which is only 334 ft. above sea level, produces a wide range of vegetable crops for the American market, although only 10% of the land in this state is under cultivation.

The bush-type outdoor tomato is probably the most important Florida crop. Large tomatoes are preferred by the consumers and three or four make up a lb. They are picked green and packed in 60 lb. boxes for transport to their destination, which may be anything up to 1,500 miles away, where they are repacked in 20 lb. containers and finally into 1 lb. self-service packages.

Second in importance to tomatoes in the American vegetable world are sweetcorns. Mr. Harrison mentioned a grower of 685 acres of sweetcorn who grades and packs the cobs in Cellophane within 30 min. of picking; thereafter they are kept under strict temperature control.

Potatoes, another important crop, are grown in very sandy soils with organic matter contents of only about 1%. Generally this is land which has been cleared of natural vegetation, consisting of palmetto, rough grass, and pine trees. Rows are set 42 in. apart to facilitate surface irrigation and spraying against blight, every four or five days, continues throughout the growing season from the time the leaves appear above the ground right through to harvest.

Every potato is washed, graded and packed at a cooperative station. Sometimes they are waxed to prevent moisture loss and coloured with red dye; this last process is the result of consumer research which has discovered that sales increase fourfold when the colour is changed from white to red.

Cucumbers are grown outside, all of the ridged type. They, too, are washed, graded and waxed before dispatch.

Black celery soils

Not all Florida's soils are low in organic matter content and there are, for example, the 'muck soils,' extremely high in organic matter and principally used for the cultivation of celery, which is carried out on the grand scale. The virgin soil is first cultivated and irrigated; 6 in. mole drains are used to cut under the soil between irrigation ditches. 2,000-3,000 lb. of complete fertiliser are added to the soil per acre, followed by heavy top dressings at an application rate of 50 acres per day per fertiliser distributor.

Celery seedlings are shade-grown, that is, protected from direct sunshine by burlap or cheesecloth 'sunshades.' 90% of the celery grown in the United States is of the pale green type, only about 10% being of the blanched variety. The sowing of the crop is planned so that from October until June there is a continuous supply of celery maturing. A massive harvesting machine is used, in conjunction with 50 coloured labourers, which trims, washes, grades and packs the celery, loading the packed crates by roller conveyor on to a truck following the whole outfit. Before being dispatched to its ultimate destination the celery is put in a cooler to bring down its temperature; field temperature may easily be 100° F. or more.

Other crops mentioned by Mr. Harrison were pepper (a very profitable crop) and watermelons, for which clean land is essential for cultivation.

New England

In New England contour ploughing is widely practised and surface irrigation considered of first importance. Light aluminium alloy pipes of 3 in. diam. are commonly used with upright rotary jets fitted every 20 ft.

Weed control is carried out extensively since petrol and oil are comparatively cheap; tractor-drawn flame guns are used and vaporising oil spraying practised. Much research work is being carried out on pre- and post-emergence sprays.

Lettuce is a very important crop for inclusion in the packeted, ready-made salads (containing perhaps eight ingredients), which are popular in the self-service stores. As the consumer buys the lettuce

already chopped the presence of a good heart is not important.

Brassica crops such as cabbages and sprouts are hardly grown at all, although kales and turnip tops are quite important.

Marketing

The spaciousness of the American co-operative stations was referred to by the speaker. Here the farmers bring their produce for sale. Refrigerated trucks, both rail and road, are extensively used for transport, the huge road trucks being recharged with ice along their route, which may be well over a thousand miles, as necessary.

Cooperative Farms in Hungary

1952 marked an increase of 658 in the number of cooperative farms in Hungary, stated Mr. Mátyás Rákosi, the Hungarian Prime Minister, when introducing the 1953 budget. An additional 92,402 peasant families possessing 998,900 acres set up cooperative farms.

There are now 5,315 cooperative farms in Hungary, he added, with 446,900 members and possessing 3,648,400 acres of land, or 24.6% of the farming area. An additional 1,666,000 acres are given over to State farms and experimental farms.

Wheat Importations by Pakistan

Pakistan, faced with a deficit of about half a million tons of wheat this winter, has announced the purchase of 100,000 tons from Canada. Normally an exporting country with half a million tons of wheat to spare, Pakistan made extensive purchases of wheat last year because of crop failures due to severe drought last season. Altogether Pakistan arranged for 550,000 tons from abroad, including 150,000 tons each from Russia and America.

Negotiations are proceeding for a further 60,000 tons from foreign countries

BULLETINS AND REPORTS

(A selection of Reports, Booklets and Miscellaneous Publications received by the WORLD CROPS *Editorial Office.)*

Population, Food and Economic Progress, by Merrill K. Bennett. This is a publication of the Rice Institute, Houston, Texas (named after William Marsh Rice), a university dedicated to the advancement of letters, science and art. Prof. Bennett traces the growth of world populations during the last thousand years, also the food supply situation during the same period, and then discusses the problems that lie before the world's population. Inclining towards the optimistic, he believes that ' man has it within his power to turn one way or another,' that is, increase food consumption levels or, on the other hand, allow lower levels to persist and even accentuate.

* * *

The Fruit Research Scheme, Bihar. A Report by Shri. R. S. Roy, Horticulturist to the Government of Bihar. This scheme was started in 1934 to carry out research on the problems of fruits in Bihar, the main object being to select types of mango, *litchi*, papaya and banana and to find the best manurial schedule for mango. The Report summarises the work that has been done during the last 17 years, including the achievement of inducing mangoes to flower every year, the discovery of various manurial requirements, fruit strain selection, grafting technique and pest and disease control.

* * *

Annual Meeting of the Midwest Barley Improvement Association. This progress report gives a *résumé* of the activities of the Association, which concerns itself with the interests of barley growers in the seven midwest states of the U.S.A., *viz.:* North and South Dakota, Illinois, Iowa, Michigan, Minnesota and Wisconsin. Variety selection, production and prices, reports of meetings, research reports, etc., are included.

Poplars. Bulletin No. 19 of the British Forestry Commission. A comprehensive account of this popular and rapid growing tree, including botanical descriptions of varieties, silviculture, diseases and pests, properties and uses. As new hybrids are being produced the choice of varieties becomes more and more bewildering and this bulletin has been written in an endeavour to clarify matters. It replaces an earlier bulletin of the Commission, published in 1923, and includes considerable information based on experience of poplar growing in Great Britain, together with foreign information.

* * *

Grain Exports by Source and Destination. A report prepared by the Commodities Division of FAO relating to the period July 1951 to June 1952. Export and import figures are given for wheat and wheat flour, rye, barley, oats, maize—and their products—grain sorghum, millets and others.

* * *

Second World Food Survey. In 1946 a World Food Survey was published by FAO as the first post-war statistical picture to serve as a guide in the campaign against hunger and malnutrition. Now, six years later, the Second World Food Survey is published; this is a more complete document, although essentially concerned with the same basic questions as the first. It is viewed in the light of post-war changes and the greater knowledge now available.

As the Director-General of FAO, Mr. Norris E. Dodd, says in his introduction: ' The Second World Food Survey is presented as a report in progress made thus far, and as a guide to future action. It is incomplete and, in many respects, provisional. But if in some degree it assists national governments, regional and international organisations to formulate plans and programmes for more intense and comprehensive action in the future, it will have achieved its purpose.'

* * *

Fertilisers: Methods of Analysis Used in OEEC Countries. The aim of this study has been to describe the methods of analysis of the more common types of fertilisers as used by the member countries of the Organisation for European Economic Cooperation (OEEC), to pave the way for an eventual understanding on internationally adopted methods for analysis of fertilisers which enter international trade. Altogether the methods of 14 countries are listed.

* * *

Cooperation Principles and Practices. This is a presentation of the principles and practices of co-operation as they have developed in the State of Wisconsin, U.S.A. Major emphasis is placed upon farmer activities and the booklet has been produced as an outline to be used in teaching cooperation in the schools of the State.

* * *

Empire Cotton Growing Corporation. A short account of the formation and objects of the Corporation, recording the progress made since it was established under Royal Charter in 1921.

* * *

Cawthron Institute, Nelson, New Zealand, 1951-52. The work of the Institute has dealt with a variety of problems associated with general farming, fruit, hop, tomato and tobacco culture. Studies of trace element deficiency in raspberries, apples and hops have been continued. Raspberries have benefited from the use of copper salts both as soil dressings and in sprays. Disease surveys have shown an extension of land affected by tobacco canker. Fertiliser trials on hops show the value of a 10-cwt. application of mixed fertiliser supplemented by a top dressing of 1 cwt. sulphate of ammonia.

WORLD CROP REPORTS

WORLD

Tobacco forecast. The world's 1952-53 (July 1952 to June 1953) tobacco harvest is forecast at 7,196 million lb. compared with 7,371 million lb. in 1951-52 and post-war (1945-49) annual average of 6,799 million lb. A 1952-53 forecast excluding the Soviet Union, China, and most of Eastern Europe is 5,298 million lb.

This forecast does not include tobacco produced and consumed domestically, but does include production in the Torrid and South Temperate zones for the 1952-53 harvests which will occur during the first half of 1953.

A substantial decrease in North America and Europe largely accounted for the lower forecast which is partially offset by moderate increases in the other continents. The decrease in production in both the United States and Europe is attributed primarily to widespread drought conditions.

The 1952-53 production of flue-cured leaf, the principal type entering world trade, will be smaller than the 1951-52 harvest. The decrease in flue-cured production in the United States is primarily the reason for the smaller world crop, as increases are indicated for Southern Rhodesia, India and Pakistan.

The 1952-53 harvest of Oriental or Turkish type leaf, another important type entering world trade, will be below the 1951-52 estimate, as decreases have been reported in practically all countries producing this type of leaf except Turkey, which shows only a slight increase. The decrease in Greece, Yugoslavia, and Italy is attributed to smaller acreages combined with lower yields this season due to unfavourable weather conditions. While the production of this type of leaf is lower, the quality is reported to be above average.

World production of light air-cured types including Burley, which represents an important portion of total production in many countries, is forecast slightly lower in 1952 because of moderate decreases in the major producing areas. This decrease is also attributed to drought conditions. The production of dark air-cured types, other than strictly cigar types, is expected to be about the same level as 1951-52. A decrease is indicated for the United States.

Production of cigar types may be slightly higher as increases are forecast for Cuba, the Dominican Republic and Indonesia, which should more than offset the decrease in the United States and the Philippine Republic.

World cacao forecast. The world production of cacao beans in 1952-53 is forecast at 1,614 million lb., which is approximately 7% above the estimated 1951-52 production of 1,508 million lb. and 2% above the pre-war average. However, it is below the record cacao production of 1950-51 which was 1,724 million lb.

The Gold Coast, Nigeria, French West Africa, French Equatorial Africa and the Cameroons are the prime producing countries of Africa. For this area the production for 1952-53 is being forecast at almost the same level as the record year of 1950-51. Harvesting of the main crop in this area begins in October and extends into January, so if the present prices in the world cacao markets remain steady, the present forecast for the African area could be exceeded slightly.

The next largest production area is South America, with Brazil the largest producer in that area. The Brazilian crop has been forecast at 206 million lb., compared to 231 million lb. in 1951-52 and 300 million lb. in 1950-51. The reduction in the forecast for 1952-53 is attributable to the severe drought which caused considerable damage when the Bahia intermediate crop was being harvested.

The North American area consisting of Mexico, Central American and the Caribbean countries is the only area where the 1952-53 crop is being forecast as exceeding the record crop of 1950-51.

Cacao, raw material of chocolate, has been an important agricultural product for more than four centuries, but it is only in comparatively recent years that it has developed into a major commodity in world trade. World exports of cacao beans increased sevenfold from 225 million lb. in 1900 to a record total of 1,655 million lb. in 1939 and have averaged 1,511 million lb. during the 1948-51 post-war years. This remarkable expansion resulted from the extension of cacao cultivation in West Africa and to the discovery of many new uses for cacao products. In 1900, more than four-fifths of the world supply of cacao beans was produced in Latin America; whereas today, Africa produces over two-thirds of the total.

Most of the world's cacao production is consumed in the United States and Europe. The United States alone imports about 40% of the total supply with an annual average during the post-war years (1948-51) of 610 million lb. valued at $170 million.

(From '*Foreign Crops and Markets*')

ARGENTINA

New year crop conditions. Moderate showers were reported from Western and Southern Buenos Aires province in early January, but otherwise the weather was dry with high temperatures. Early sown maize suffered from a lack of rains and heavy losses were expected. On the other hand, sunflower crops were progressing well. Harvesting of fine crops continued steadily with wheat harvesting nearing completion in the Northern Provinces where exceptionally high yields are reported.

Trade circles now estimate total production of wheat at around eight million tons compared with the meagre two million last year.

BRAZIL

Carnauba wax forecast. Prospects for a better than average carnauba wax crop in Brazil during 1952-53 continue, although a previous forecast of 13,200 short tons has been reduced to about 12,650 tons, according to the American Consulate, Fortaleza. The first cutting of carnauba fronds has been completed and the size of the December-January cutting will be determined largely by the general interest displayed in the crop during this period. Production of carnauba wax in 1951-52 amounted to about 12,300 tons.

Exports of carnauba wax continue to be much less than normal. Export data for 1952 are not yet available, however.

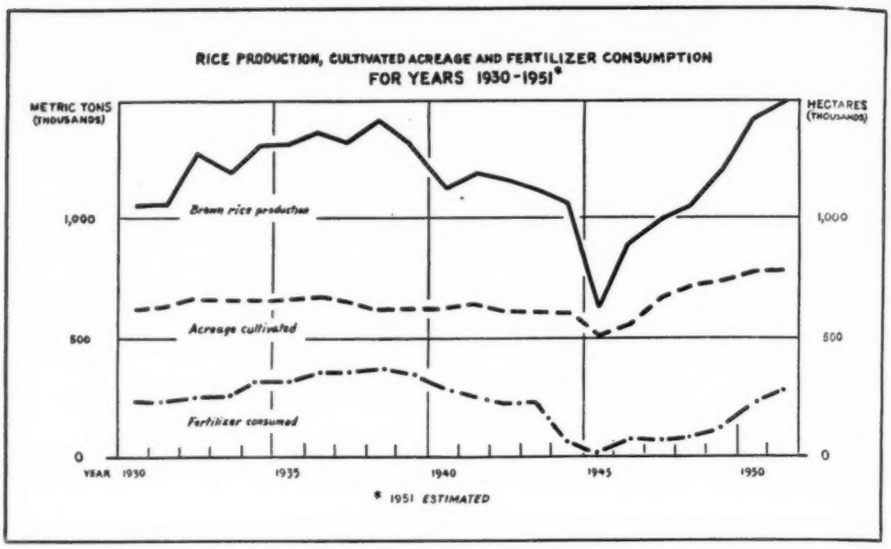
Interest in the current crop is presently sustained by the financing and purchase programme initiated by the Brazilian Government last May. Information furnished by the trade indicates that the Government had purchased or financed about 4,400 tons of wax by mid-October. There is no clear indication that the Government intends to buy or finance all stocks of wax which may be offered, although the programme has been extended to cover the current crop.

INDONESIA

North Sumatra rice production will soon be sufficient for local needs, it was stated by Mr. T. Daudsjah, Resident-Assistant to the Governor of North Sumatra. If the development of agriculture continued, North Sumatra could become self-supporting as regards rice, within the next five years. The rice harvest of 1952 yielded 900,000 tons, and it would only be necessary to import 100,000 tons for estate workers, since local supplies from West Sumatra were sufficient to meet the needs of the rest of the population. Steps were now being taken by

the State Plantation Enterprises (PPN), Daudsjah continued, to increase yields by more extensive mechanisation. Mechanical cultivation had already been applied successfully over an area of 3,000 hectares in South-East Sumatra, and in 1953 mechanisation will be introduced on 7,000 hectares of ricefields in Atjeh.

Rice production in West Java reached a peak in 1952, it is announced by the People's Agricultural Inspectorate in Bandung. During 1952 3.5 million tons of rice were harvested in West Java, 600,000 tons more than the highest pre-war figures. Losses, caused by floods and insect pests during the year amounted to some Rp. 60 million. Despite the rise in output, the needs of West Java cannot yet be met in 1953, owing to the increase in the population and other factors.



Production of brown rice in Taiwan (Formosa), cultivated acreage and fertiliser consumption

INDIA

Successful Virginia-type tobacco cultivation. The Government of Bahawalpur has announced initial success in experimental growing of Virginia-type leaf, according to L. P. Poullada, American Consulate, Lahore. The announcement stated that a two-year average yield per acre of 948 lb. has been attained from the Virginia-type leaf. Since the experiments have proved so successful, the Bahawalpur government is planning large-scale plantings in order to supply good quality leaf to the province's cigarette factory. Flue-cured production for all of India in 1951-52 is estimated at 95 million lb., about 87 million lb. of which was produced in Madras.

ISRAEL

Increased beet sugar production . . . 200,000 dunams of winter crops, including extensive areas in the Negev, were sown last year by farmers of the Jezreel, Gilboa and Beth Shean districts of the Eastern Emek. Following last season's gratifying results, farmers in the area have sown 1,700 dunams of sugar beet. A sugar refinery is to be constructed at Affula.

. . . and tobacco. Over 1,000 tons of tobacco leaf, cultivated on 20,000 dunams of land, had already been picked in Galilee by mid-January in the course of the present harvest which came to a close in January. Last year 1,700 tons were reaped throughout the country. This year's crop was reported as excellent and in addition to effecting a considerable saving in foreign currency by supplying all local consumption of the oriental type of tobacco, the crop is becoming an increasingly important export commodity.

PARAGUAY

Sugar expectations. The 1952 cane sugar crop is expected to yield about 22,000 metric tons which compares with 20,596 tons in 1951 and 22,402 tons in 1950. Paraguay neither imports nor exports sugar. Prior to the war internal consumption was little more than one-third of the current rate. The minimum price of cane, according to the Board of Trade Information Service, is 90 guaranies per ton, which is double last year's price.

(From Czarnikow's *Sugar*.)

AUSTRALIA

Wheat estimates. Prospects for the Australian wheat crop have improved and production is forecast at about the same figure as the 1951-52 harvest.

The present estimate of 160.8 million bushels is about the same as the revised estimate of 159.7 million bushels for last year's crop. Though little change is indicated in the total, sizeable changes are noted for some States. The largest change is for Queensland, where the crop is estimated to be more than double that of last season, because of a substantial acreage increase and better yields. An offsetting reduction is reported for Western Australia, where unfavourable growing conditions have lowered yields and the October rains were too late to repair damage caused by sub-normal moisture in the northern and central areas of the State throughout the growing season.

Deliveries to the Australian Wheat Board appear likely to be about the same as the 145 million bushels delivered in 1951-52. The exportable surplus from that amount, after deducting domestic requirements, would be around 75 million bushels. As this is below Australia's export commitment of 88.7 million bushels under the terms of the International Wheat Agreement, it would seem that, as in the 1951-52 year, the quota will have to be reduced.

ACREAGE AND PRODUCTION OF WHEAT IN AUSTRALIA (BY STATES), 1952-53, WITH 1941-50 AVERAGE FOR COMPARISON

STATE	*Average 1940-41 to 1949-50*	1952-53 *(Preliminary estimate)*
	1,000 *acres*	1,000 *acres*
ACREAGE		
New South Wales	3,834	2,300
Victoria	2,731	2,280
Queensland ..	387	700
South Australia ..	2,107	1,530
Western Australia	2,290	3,000
Tasmania ..	6	6
Australian Capital Territory ..	3	1
Total ..	11,358	9,817
PRODUCTION ..	1,000 *bu.*	1,000 *bu.*
New South Wales	50,883	42,000
Victoria	35,757	44,000
Queensland ..	7,151	16,000
South Australia ..	25,078	26,000
Western Australia	26,562	32,700
Tasmania ..	118	120
Australian Capital Territory ..	49	10
Total ..	145,598	160,830

The biggest rice crop in the history of the Northern Territory is currently being planted by the Northern Territory Administration, reports our Australian Correspondent. From 80 to 100 acres are being sown at three experimental stations within 60 miles of Darwin. Among the varieties being planted are some imported from Malaya, the Philippines and North America.